VOL. XXXVIII, No. 1, 1955

MONWEALTH INST.
MOLOGY LIBRARY
- 1 JUN 1955
L As.1T
RATE

THE

MALAYAN AGRICULTURAL JOURNAL

PRINCIPAL CONTENTS

SOIL SURVEY REPORTS. NO. 2. A PART OF WEST SINGAPORE ISLAND BY W. P. PANTON, B.SC. (HONS.), D.T.A.

INVESTIGATIONS INTO THE MECHANICAL COLLECTION AND BALING OF PADI STRAW DURING THE 1953-54 HARVEST BY D. M. HAYNES, B.SC., A.M.I.B.A.E.

NOTES ON CURRENT INVESTIGATIONS, RESEARCH, OCTOBER TO DECEMBER, 1954.

NOTES ON CURRENT INVESTIGATIONS, AGRONOMY, OCTOBER TO DECEMBER, 1954.

NOTES ON EXTENSION WORK, OCTOBER TO DECEMBER, 1954.

DEPARTMENT OF AGRICULTURE, FEDERATION OF MALAYA.

Kuala Lumpur.

PRICE $2

DEPARTMENT OF AGRICULTURE, FEDERATION OF MALAYA.

ORGANIZATION (as at 31st January, 1955).

Director of Agriculture:—O. J. Voelcker, C.B.E., M.A., A.I.C.T.A. (*On leave*).
R. G. Heath (*Acting*).

Deputy Director of Agriculture:—R. G. Heath, B.Sc. (Agr.), A.I.C.T.A.
J. R. Curry (*Acting*).

Administrative Officer:—H. F. Logan. (*On leave*).

Office Assistant:—Low Kim Ann.

Financial Assistant:—V. Sundram.

RESEARCH BRANCH.

Chief Research Officer:—

R. B. Jagoe, B.Sc. (Hons.).

(II) BOTANY.

Senior Botanist:—

L. N. H. Larter, B.Sc. (Hons.), A.R.C.S., A.I.C.T.A.

Plant Breeders:—

F. B. Brown, B.Sc. (Hons.), Dip. Agr. Sci. (Camb.).

A. V. Haddon, B.Sc. (Hons.), Dip. Agr. Sci. (Camb.).

Chew Hong Jung, B.Sc. (Hons.), B. Agric.

Van Thean Kee, B.Sc. (Hons.).

*W. F. Grant, M.A., Ph.D.

Mrs. B. Chapman, B.A. (Hons.) (Camb.). (*Temporary*).

Plant Physiologists:—

J. Dore, B.Sc. (Hons.), Ph.D., A.R.C.S.

*R. G. Lockard, B.S.A., M.Sc. (Agric.).

Asst. Research Officer:—

Tak bin Haji Daud.

(III) CHEMISTRY.

Senior Chemist:—

A. E. Billington, M.A., A.R.I.C.

Canning Officer:—

(*Vacant*).

Chemists:—

G. Youatt, B.Sc. (Hons.), Ph.D.

Miss M. Smith, B.Sc. (*Temporary*).

One vacancy.

Assistant Chemist:—

K. Kanapathy, B.Sc. (Hons.) (Madras). (*At present on Scholarship Course*).

Kao Wei Tsan, B.Sc. (Lingnan).

(IV) SOIL SCIENCE.

Senior Chemist (Soils):—(*Vacant*).

J. K. Coulter. (*Acting*).

FIELD BRANCH.

Chief Field Officer:—

J. R. Curry, Dip. Agr. Sci. (Dunelm), N.D.A.

J. Cook, B.Sc. (Hons.), A.I.C.T.A. (*Acting*).

Agricultural Economist:—

T. B. Wilson, B.A. (Oxon), Dip. Agric. Econ., D.T.A.

Personal Assistant to Chief Field Officer:—

Yoon Weng Kong.

KEDAH & PERLIS: *State Agricultural Officer (Kedah and Perlis)*:—

E. J. H. Berwick, M.A., Dip. Agric. Sci. (Camb.), A.I.C.T.A.

Agricultural Officer:—

M. G. Hawson, B.Sc. (Agric.).

Asst. Agricultural Officers:—

Hj. Mohd. Salleh bin Musa.

Salim bin Mhd. Akib.

Abdul Hamid bin Haji Hussain (*Perlis*).

KELANTAN: *State Agricultural Officer*:—

R. Henderson, M.C., B.Sc. (*Acting*).

Asst. Agricultural Officer:—

Hj. Mahmud bin Haji Yaacob.

TRENGGANU: *State Agricultural Officer*:—

A. L. Barcroft, B.Sc.

Asst. Agricultural Officer:—(*Vacant*).

PENANG & PROVINCE WELLESLEY: *Settlement Agricultural Officer*:—

J. R. Milburn, B.Sc. (Dunelm), D.T.A.

Asst. Agricultural Officer:—

Mohd. Noordin bin Mohd. Kassim.

PERAK: *State Agricultural Officer*:—

H. J. Simpson, P.J.K., B.Sc. (Agr.), Dip. Agri. (Wye).

Agricultural Officer:—

Perak North—Ahmad bin Mhd Amin, B.Sc. (Agric.).

* Supernumerary appointments under the Colombo Plan.

(*Continued*)

ERRATA

Malayan Agricultural Journal, Vol. XXXVII, No. 4.

Page 212, Marketing, line 9:

for "workers in rubber estates" read

"workers on rubber smallholdings".

Page 230, Spices, lines 1 and 2:

for "*Jambosa caryophylla* (Spreng)

(= *Eugenia aromatica*)" read

"*Eugenia caryophyllata* Thunb".

THE

Malayan Agricultural Journal

Edited by the Publications Officer with the assistance of
The Publications Committee.

Vol. XXXVIII **No. 1, 1955.**

Errata, Vol. 37, No. 4

Editorial 1

ORIGINAL ARTICLES.

Soil Survey Reports. No. 2, A Part of West Singapore Island by W. P. Panton, B.Sc. (Hons.), D.T.A. 2

Investigations into the Mechanical Collection and Baling of Padi Straw during the 1953-54 Harvest by D. M. Haynes, B.Sc., A.M.I.B.A.E. 27

Notes on Current Investigations, Research, October to December, 1954 38

Notes on Current Investigations, Agronomy, October to December, 1954 44

Notes on Extension Work, October to December, 1954 .. 49

REVIEW.

Methods of Surveying and Measuring Vegetation 54

DEPARTMENTAL.

Departmental Notes 55

STATISTICAL.

Market Prices, October to December, 1954 60

Production of Palm Oil and Kernels, Federation of Malaya .. 62

Malayan Agricultural Exports, July to September, 1954 .. 62

Rubber Production, Federation of Malaya 63

Copra, Coconut Oil and Copra Cake Production, Federation of Malaya 64

Meteorological Summary, September, 1954 65

Meteorological Summary, October, 1954 66

Meteorological Summary, November, 1954 67

Meteorological Summary, December, 1954 68

THE MALAYAN AGRICULTURAL JOURNAL

The Journal is designed to present—as far as possible in non-technical terms—the results of the agricultural research, investigation and extension work in Malaya performed by the Department of Agriculture. Also, by means of selected articles, abstracts and reviews, this publication draws attention to the results of work of a similar nature in other countries, which have a bearing on agriculture in Malaya.

The Journal is published quarterly.

PRICE $2 PER COPY OR $8 PER ANNUM, POST FREE IN MALAYA; $8.50 OR £1 STERLING, POST FREE OUTSIDE MALAYA.

Publications may be obtained from the Department of Agriculture, Kuala Lumpur, Federation of Malaya, or from the Office of the Commissioner for Malaya in the United Kingdom, 57, Trafalgar Square, London, W.C.2.

A remittance to cover cost should accompany application for publications. Malayan currency $1 = 2s. 4d.

COMMITTEES OF THE DEPARTMENT

Standing Committee on Investigations.

The Deputy Director of Agriculture. (*Chairman*).
The Chief Research Officer.
The Chief Field Officer.
The Senior Agronomist.
The State Agricultural Officer, Selangor.
The Agronomist-in-Charge, Federal Experiment Station, Serdang.
The Publications Officer. (*Secretary*).

The Publications Committee.

The Director of Agriculture, Federation of Malaya. (*Chairman*).
The Deputy Director of Agriculture.
The Chief Field Officer.
The Chief Research Officer.
The Senior Agronomist.
The Publications Officer. (*Secretary*).

Examinations Board.

The Deputy Director of Agriculture. (*Chairman*).
The Chief Field Officer.
The Chief Research Officer.
The Senior Agronomist.
The Principal, College of Agriculture, Malaya.

The Advisory Council, College of Agriculture, Malaya.

The Director of Agriculture, Federation of Malaya. (*Chairman*).
The Director, Rubber Research Institute of Malaya, Kuala Lumpur.
The Principal, Sultan Idris Training College, Tanjong Malim.
The Principal, College of Agriculture, Malaya.
The Director, Veterinary Services, Federation of Malaya.
The President, United Planting Association of Malaya.
The President of the Malayan Estate Owners' Association.
Dato Abdul Razak bin Dato Hussein, Kuala Lumpur.
Secretary of the Alumni Association, College of Agriculture, Malaya.
The Commissioner for Co-operative Development, Federation of Malaya.
The Registrar and Bursar. (*Secretary*).

THE

Malayan Agricultural Journal

Vol. 38, No. 1, 1955.

EDITORIAL.

Some Soils of West Singapore Island. With a view to the expansion of the area under food crops on Singapore Island, the Government of Singapore sought and obtained the loan of the services of the Geologist (Soil Survey) of the Department of Agriculture, Federation of Malaya, Mr. Panton, for a survey of the soils in an area of about 16,000 acres situated on the western side of the island. Analyses of the soil samples obtained were carried out by the staff of the Department in Kuala Lumpur.

A slightly shortened version of Mr. Panton's report (some tables have been omitted) to the Singapore Government appears as the first contribution to this issue of the Journal, and the Publications Committee are grateful to the Singapore Government for permission to publish it.

The results of the survey illustrate the close correlation existing between the soils and the underlying rocks, and to a lesser extent the importance of the topographic factor. In this respect the soils are typical of those occurring over the greater part of the Peninsula.

The poor fertility of many of the soils in Singapore, and in Malaya generally, helps to emphasise the importance of soil survey both in planning the development of new areas of the country, and in the selection of the soils most suited for intensive cultivation in the already developed regions, where increasing populations may bring about local land shortage. This latter problem has arisen in Singapore where vegetable growing for local consumption is of considerable importance, and the present survey was carried out primarily to give some indication of the general suitability and potentiality of one typical area.

The Mechanical Collection and Baling of Padi Straw. Although there is a potential market for padi straw in most rice-growing areas of Malaya it is unusual for those farmers who do not own livestock to collect and sell the straw remaining after the padi has been harvested. It is probable that this failure to take advantage of the opportunity to earn a few extra dollars is due to the difficulty of collecting and baling the straw by hand and then transporting it to the buyer. With these difficulties in mind officers of the Department carried out trials with a mechanically propelled buckrake and mechanical balers. In the article commencing on page 27, Mr. Haynes, an Agricultural Engineer, describes the investigations and gives details of the costs of collection, baling and delivery of padi straw.

SOIL SURVEY REPORTS. No. 2, A PART OF WEST SINGAPORE ISLAND

BY

W. P. PANTON,

Geologist (Soil Survey)

PART I. Introduction.

The terms of reference for the present survey were:- "To carry out a soil survey of a selected area in Singapore Island, classify the soil of the area into different soil types and give some indication as to their relative suitability for food production, especially vegetable growing, by Chinese market gardeners".

The area finally chosen for the survey totalled approximately 16,000 acres including both Crown land and private land situated on the western side of the island. It comprised a strip averaging about 3 miles in width and 10 miles in length running in a north-south direction between the Johore Strait in the north and Selat Sembilan in the south.

The field work occupied a period of four months. The survey methods used were based on the system of soil classification developed by the United States Soil Survey, in which slope and erosion classes are combined with the soil types to give a series of three part mapping symbols. These soil-slope-erosion groupings can then be used as the basis in planning for advisory and extension work, while the soil types can be arranged in a suitability table for a specific crop or crops. Such tables have been drawn up for the two main types of vegetables and are included in the report. In addition, a soil map of the area is included as an appendix.

Detailed descriptions of all the soil series and types are given and the suitability of each soil for the various crops is indicated. The results of chemical and mechanical analyses carried out on samples from test pits dug in typical areas are also included, and from these figures a number of tentative conclusions are drawn concerning the fertiliser requirements of the various soils.

General Description of the Area.

The characteristic features and properties of a soil result from the interaction of a number of factors, and a short review of each of these soil forming factors as they exist in the surveyed area are given in the following paragraphs.

GEOLOGY.

The parent rocks include a sedimentary formation of Triassic or Carboniferous age from which most of the hill soils are derived, a small area of intrusive rocks of acid and basic composition which give rise to some of the hill soils in the north-east corner, and the recent deposits from which the alluvial soils occurring in the swamps and valley bottoms are developed.

The older sedimentary group has a rather mixed composition and includes an argillaceous series of shales with included beds of sandstone, and an arenaceous series of sandstones and conglomerates with occasional shales. The rocks of the argillaceous series have a variable iron content, the more iron-rich bands giving rise to the strongly lateritic soil of the Ulu Pandan Series while the light coloured iron-poor shales are the parent rocks from which the Lokyang Series is developed. Rocks of intermediate iron content and slightly sandier texture are covered by soils of the Malacca, Peng Siang, Bukit Susop, Choa Chu Kang and Ayer Terjun Series. The arenaceous series is found in the area covered by the Serdang Series soils together with some of the coarser grained examples of the Peng Siang Series.

The acid igneous rocks underlie the small area of Rengam Series soils while the basic igneous group, which is of noritic composition, is the parent rock from which the Sungei Kadut and Bukit Panjang Series have been formed.

Finally, the recent alluvial deposits, which include sands and clays together with deposits of peat, are covered by soils of the Tengah, Lam San, Jurong, Chew Boon Lay and Kranji Series.

Topography.

The mapped area includes the greater part of the Sungei* Kranji and Sungei Jurong Basins together with the moderately undulating country forming the watershed between them. The soils of the Kranji and Jurong Series occur on the larger alluvial flats along the main streams, while the Tengah Series is confined to the smaller alluvial strips along the tributaries. The Chew Boon Lay Series is found only in two large inland flats which drain into the Sungei Jurong. The rising land forming the watershed is covered with soil derived from Triassic parent material and consists chiefly of Peng Siang and Lokyang Series.

Along the western edge of the map, the country is undulating to hilly and includes the steeply sloping Bukit Susop hill range in the south-west corner. A north-south traverse through this area would include examples of all the more important series derived from Triassic rocks.

On the eastern side, the strongly undulating and hilly country includes a large area of the Ulu Pandan Series, some Serdang and Peng Siang, and the three series derived from igneous rocks bordering the Bukit Timah Road.

Climate.

There are no major climatic differences over the area and all the soils may be considered as having formed under the same climatic influence. Temperatures average between 75°F. and 85°F. and humidity is high, while yearly rainfall is about 100 in., with monthly maxima of around 15 in. during the monsoons and occasional dry months when the precipitation may be as low as 2 in.

Vegetation.

The natural vegetation originally consisted of jungle and mangrove swamp. The jungle has been cleared entirely, throughout the area, and the

* **Sungei = river.**

rich surface layer of the jungle soils has largely disappeared as a result of exposure, erosion, and exhaustion. The mangrove swamp still covers extensive areas of the Kranji Series.

Methods of Survey.

Alternate coverage (30 per cent overlap) aerial photographs on a scale of 1 : 6,000 were used as the base maps and these increased both the speed and accuracy of the mapping much above that which could have been achieved using the 8 chain Land Office sheets. Soil boundaries and other information were plotted directly on to the photographs using coloured chinagraph pencils, these lines being later permanently marked with standard drafting inks.

A short preliminary reconnaissance survey was first carried out and the more widespread soil series established by digging 6 ft. pits at selected points. The soil profiles exposed in this way were examined in detail and, where necessary, sampled for laboratory analysis. At the same time provisional slope and erosion classes were set up and their applicability tested on the various soil types. In this way the classification, which formed the foundation for the detailed survey, was built up, and apart from the addition of new soil series recognised during the course of the survey, the original classification required very little subsequent alteration.

A 3ft. screw-type auger, changkol, and small hand trowel were used for soil examination during the field work, and traverses were made at approximately 300 yards intervals. It was found that an average of 400 acres could be covered during a normal day's work, provided no time was spent in pit digging and examination. During the final month several days were lost owing to heavy rains.

Soil Series and Types.

The basis of the soil classification was the soil series, differentiation between one series and another being based on the variation in the morphological features of the profile. Seventeen separate series were recognised as occurring within the area and a number of these were sub-divided into soil types. These soil types have similar morphological characters in the profile but differ in the texture of the topsoil. Soil series are identified on the photographs by numbers, and different types within a series are indicated by a small letter placed immediately after the number. The series are described in alphabetical order in Part II of the Report.

Slope Classes.

The slope classes are as follows:-

A	=	0 — 2°
B	=	2°— 5°
C	=	5°—12°
D	=	12°—25°
E	=	25°—45°
F	=	45° +

A Slopes. Level or almost level areas where erosion is extremely unlikely. The soils developed on such sites are generally alluvial types

in which the drainage of the subsoil is badly impeded. Accumulation of recent erosion material brought in by streams often occurs on such slopes, and buried horizons of organic soil are common.

B Slopes. Gently undulating or gently sloping land the erodability of which varies considerably with the soil type. Shallow lateritic soils are the types most liable to serious damage on these low angle slopes, owing to the fact that a very slight top-soil loss leads to rapid exposure of the hard concretionary ironstone layer. Erosion is very seldom spectacular on such slopes and for this reason it is difficult to convince the farmer that it takes place at all, but careful examination of the ground usually gives the lie to such ideas, particularly under clean weeded tree and food crops; protection by cover cropping or terracing would have saved much of this land in the past, and such conservation measures are more than ever necessary at the present time.

C Slopes. Moderately and strongly sloping and undulating land on which serious erosion damage is often apparent. Complete topsoil loss has occurred over large parts of the surveyed area on some of the shallower lateritic soils and the land has been virtually ruined as a result. The soils found on 'C' slopes vary widely in their susceptibility to erosion but the risk, in greater or lesser degree, is present in all cases, and must be guarded against.

D Slopes. Found in hilly areas where the angle of slope is very strong. Such land is described as medium-steep or hilly. Run-off in heavy rain is rapid on most soils in this class and such land is generally suitable only for tree crops. Large areas formerly under rubber are now derelict and only the deeply weathering, non-lateritic, permeable soils such as those developed over granite have any worthwhile agricultural value. Serious sheet erosion or gullying are common features in areas of 'D' slopes.

E Slopes. Occur in areas of steep land and are rare in the present survey area, being only found as small patches within larger areas with 'D' slopes. Soils in such situations are unlikely to have any agricultural value.

F Slopes. These have not been encountered in the present survey, but are included in the table to allow for future extension of the classification to areas where such steeper slopes can be expected.

Accurate slope measurement can be made in the field using a small, hand Abney level, but in practice the slope is normally estimated by eye.

With experience it is possible to estimate with an accuracy of 1° and the Abney is used only for checking in borderline cases.

Erosion Classes.

Owing to the difficulties involved in the accurate estimation of erosion, the classification used is of a rather simple form and consists of four classes. It should be noted that the erosion class number indicates the state of erosion at the time of survey and does not directly indicate the susceptibility of the land to erosion. Any one piece of land is thus liable to undergo a rapid change in erosion class as a result of variations in soil management which may have taken place since the survey was carried out. The table refers, of course, to erosion by water, no evidence of wind erosion having been found.

Class 1 Slight loss of topsoil resulting in a rather thinner organic topsoil horizon than is normal for the particular soil type. A few small rills may be evident.

Class 2 Almost complete loss of the organic topsoil resulting in exposure of the former subsoil. As the topsoil layers of most of the types occurring in the surveyed area are rather thin, Class 2 erosion frequently results after a loss of as little as 3 in. of surface soil. Rills and small dumps of erosion wash are common.

Class 3 Severe sheet erosion of the subsoil. In the case of the shallower lateritic types this results in exposure of the laterite on the surface.

Class 4 Severe gully erosion. Found mainly on the sandy non-lateritic soils without hard pans or laterite. Such erosion is not common in west Singapore owing to the widespread development of soils with resistant subsoil horizons, and is more typical of those developed over granite or the more arenaceous type of sediments.

The three part mapping symbol used to identify any given soil area on the field photographs is made up firstly of the soil series number, with the type letter added immediately after when necessary, secondly by slope class, marked by a capital letter, and lastly by the erosion class number. For example, the symbol 26a C 1 identifies an area of Peng Siang fine sand occurring on a slope of between 5 and 12° which shows a small amount of topsoil erosion. The small letter after the series number is omitted in cases where only one soil type is developed within a series, while absence of an erosion number from the symbol indicates an uneroded soil phase. Fractional symbols are used to indicate areas where a complex pattern of two slope or two erosion classes exist, as for example 26a $\frac{C}{B}$ or 26a C$\frac{1}{2}$.

The soil map included as an appendix has been made from the completed photographs and shows only the soil series boundaries, which are marked by the series number and a specific colour. The slope and erosion

class are not shown. The original field photographs are available for reference at the Department of Agriculture, Singapore.

Stream Classification.

Water supply is of considerable importance to the peasant farmer, particularly to those who specialise in the growing of leafy vegetables, and a simple stream classification has been set up with a view to helping in the selection of sites for future market gardening areas. Three grades of stream have been recognised and are described as follows:-

Class 1 Streams 10 ft. or more in average width; these streams carry sufficient water for most agricultural needs and are unlikely to dry up even during times of extreme drought.

Class 2 Streams varying in average width from 10 to 2 ft., and carrying a reasonable supply of water during times of heavy and moderate rainfall, but are likely to be reduced to a mere trickle or even dry up completely during long dry spells.

Class 3 These are streams which average less than 2 ft. across, carry a rather variable supply of water, and are likely to dry up completely even during short dry spells.

This stream classification is marked only on the aerial photographs.

PART II. Description of Soil Series.

Seventeen separate soil series have been differentiated on variation in morphological features of the profile, while a number of these have been subdivided into soil types according to textures of the topsoil.

Tables of soil characteristics showing, also, the categories of surface slope, erosion status, and natural fertility are attached at the end of Part II. The topographical and soils map is attached at the end of the Report.

Aik Hong Coarse Sandy Loam. Series 31.

This poor, sandy, free-draining soil is found on strongly sloping land about one mile north of the 12th milestone, Choa Chu Kang Road. It only occurs over an area of about 150 acres and is derived from a coarse arenaceous sediment. Very stunted, low yielding rubber is the chief crop.

Soil Profile.

The topsoil consists of a dark grey to grey sandy loam between 3 and 6 in. thick, loose and well drained and having a weak, subangular crumb structure. This is underlain by a rather close packed, reddish-yellow, coarse sandy loam, well drained and moderately well rooted. There is a gradual increase in compaction with depth, and roots are generally absent below 4 ft. One or two dusky-red mottles may be apparent at the base of this subsoil horizon and small pebble bands may sometimes occur. A pale-yellow, compact, coarse sand is found at a depth of about 6 ft. and this represents the

parent material, which is probably a deeply weathered coarse sandstone or grit.

FERTILITY.

The fertility is very poor, and available phosphate and potash values are low to very low. The soil is free-draining and highly leached in the surface horizons and dries out very rapidly, thus making it unsuitable for vegetables. Gully erosion is a constant danger and several deep gullies can be seen on some of the steeper slopes.

Ayer Terjun Clay to Sandy Loam. Series 28.

A poor, shallow soil which is found only in small patches in association with the Ulu Pandan Series. The parent material, of Triassic age, includes iron-rich shales and clays which are frequently interbedded with bands of soft sandstone, and this variability results in the formation of a wide variety of textural types. Subsoil drainage is slow, particularly in the heavier soils. In undulating country excessive run-off during heavy rains may result in serious erosion.

SOIL PROFILE.

A greyish-brown to dark reddish-brown well rooted topsoil an inch or two thick is underlain by a rather compact, reddish subsoil with a coarse, blocky structure. The number of roots decreases rapidly with depth and the soil becomes increasingly compact and very difficult to dig, until at a depth of 2 ft. the dusky-red parent material zone is entered. The original geologic banding is readily apparent and the material shatters along the bedding planes when disturbed; roots are completely absent and water movement is slow. A thin band of laterite may occasionally be found at the top of the parent material horizon but this is not an essential feature of the profile.

FERTILITY.

This varies from low to very low, and analysis shows that both phosphate and potash are present only in small quantities. The very restricted root room means that the productivity is largely dependent on the accumulated richness of the topsoil layer, and the soil is thus liable to rapid deterioration after the loss by erosion of as little as 2 in. of topsoil.

Rather stunted rubber and fruit trees are the only crops found on this soil, which appears to be generally unsuitable for cultivation.

Owing to its very spasmodic occurrence within the Ulu Pandan Series the boundaries of this soil have not been plotted in any detail, although one or two of the larger outcrops are separately marked with the symbol 28 on the aerial photographs.

Bukit Panjang Clay to Sandy-Clay Loam. Series 64.

This is a deep, well structured red soil developed over basic igneous rocks of noritic composition and is found in undulating and hilly country west of the Bukit Timah Road in the area of Bukit Panjang village. Drainage is good and roots are able to penetrate deeply into the subsoil so that it is ideal

for tree crops. Unfortunately however, quarrying and military reservations prevent much of this soil from being used for agriculture.

Soil Profile.

A beautifully structured dark brown or dark reddish-brown clay to sandy clay loam about 6 in. thick is characteristic of the surface soil, which is excellently drained and aerated. This is underlain by a reddish-brown soil of similar texture and good friable consistency which is easily dug, very well rooted, free-draining and well aerated. There is a gradual colour change to red at a depth of between 18 in. and 2 ft. which coincides with a drop in organic matter content as shown by analysis. However, the soil below this level is still an ideal rooting medium as judged by the prolific rooting which often continues to a depth of 4 ft. Below this, the red clay becomes more sandy or even gritty and inclusions of decomposed norite rock appear. At first these are only an inch or so across and can be easily broken with a trowel or even, in some cases, crushed between the fingers, but at a depth of 6 ft. hard resistant boulders of the decomposing parent material are reached, and at this depth tree roots have disappeared and further digging is impossible.

Unfortunately this soil is not very widespread and has a rather patchy distribution around the lower sides of the steeper norite hills. A gradual shallowing of the profile takes place towards the hilltops until finally the decomposing fragments of parent material appear within 6 in. of the surface. The soil shows several other minor variations and detailed examination of these very spasmodic phases was not undertaken. It is suspected that the basic rocks in this area have a rather variable composition resulting in a complex soil pattern, the interpretation of which would involve much detailed mapping.

Fertility.

Judging from the growth of rubber, pepper and fruit trees, the fertility appears to be moderately good, and the physical structure is undoubtedly an important factor in bringing this about, since analysis shows rather low values for available potash and phosphate. Despite its occurrence on 'C' and 'B' slopes, erosion risk is very slight, and this also can be attributed to the good physical structure which permits free subsoil drainage. At present none of these soils is under vegetable cultivation and their very free drainage, steep slope, and general absence of a good water supply appear to be the chief adverse factors.

Bukit Panjang Stony-Clay to Stony Sandy-Clay Loam. Series 64a.

This is a stony phase of the normal Bukit Panjang Series described above. It differs in having a very much shallower profile which includes stones and small boulders of weathered norite within the top 6 in. Boulders of the parent material are usually found at a depth of two or three feet and the unweathered rocks may even outcrop on the surface in extreme cases.

It is found on the tops and upper slopes of the steeper norite hills, and although much of the land is derelict or occupied by military camps,

reasonable growth of rubber and pepper can be seen in a few places. This soil is not suitable for vegetables.

Bukit Susop Stony Loam. Series 124.

A very poor, thin, stony soil covering steeply sloping hills to the south of Lokyang village. Laterite and lateritic rock fragments occur throughout the profile, which is extremely shallow and normally truncated by erosion. The parent material consists of banded clays, shales and sandstones of Triassic age while the vegetation is mainly a very sparse type of scrub with occasional poor, stunted rubber.

Soil Profile.

The surface soil consists of a dark brown, well-drained loam with a hard subangular or granular crumb. Small laterite pebbles are usually present very close to the surface, and all sections of this soil appear to have been subjected to erosion at some time in the past, so that the exact nature of the virgin profile is unknown. At a depth of about 4 in. a strong, brown-coloured laterite subsoil is developed which is made up of variable-sized laterite concretions and/or lateritic rock fragments formed by precipitation of iron oxide around the less weathered pieces of parent material. This horizon, which is over 50 per cent stone, is very difficult to dig and makes a poor rooting medium. It is generally between 2 and 3 ft. thick and is underlain by a yellowish-red loam which is packed with large and small elongated boulders of laterised shale or sandstone. Banding in the parent material is often seen at this depth and the unweathered rock probably lies very close to the surface.

Fertility.

This is an extremely poor soil and both phosphate and potash values are low or very low. It is however the physical state which is the chief growth limiting factor, the high stone content and compact nature of the subsoil restricting plant roots to the thin cover of surface soil. In addition, the occurrence of this soil over steep land (20° slopes are common) has resulted in much erosion at some time in the past when large areas were planted with rubber. Some of these original trees are still standing but many areas have been cut down for firewood and are now derelict. The soil is unsuitable for any type of permanent agriculture and even re-afforestation would be difficult.

Chew Boon Lay Muck. Series 11.

This is a soil of high organic matter content which is found in association with the clay and clay loam soils of the Jurong Series in the large inland flats south of Jurong village and north of Kampong Ulu Jurong. It is more common towards the centre of these areas while the Jurong soil is generally found around the edges. Where the two occur in the same district, they have been mapped as a complex.

Soil Profile.

A dark brown, loose, moist muck* up to 20 in. thick forms the topsoil, and this is underlain by a stiffer, more compact, waterlogged horizon of the same material which may include a few bands of fine sand, silt, or clay. Peat may also occur in the lower horizons and the depth of the mixed muck and peat zone is generally greater than 6 ft.

Fertility.

Rubber and pineapples, with coconuts mostly on the boundaries, are the main crops found on this soil while several large areas in which the drainage is particularly poor are at present under scrub. Vegetables can be seen growing south of Lokyang village, and large parts which are at present derelict could no doubt be used for most types of vegetables provided the drainage were improved, the salts removed, and the high acidity ameliorated by liming.

Choa Chu Kang Sandy Loam to Sandy Clay. Series 26b.

Only about 200 acres of this soil are shown on the map; it occurs south of the 15½ milestone, Choa Chu Kang Road, but it is believed that a wide band continues into the unmapped area to the north-west. The parent material is probably a fine grained sandstone and sandy shale formation of Triassic age which has a rather low iron content, and the resultant soil is similar to some of the coarser phases of the Peng Siang Series with the exception that there is no laterite formation in the lower horizons. It is typically developed over gently undulating land. Drainage is good, and the soil is suitable for most tree crops and the more drought-resistant vegetables.

Soil Profile.

The topsoil is a light yellowish-brown sandy loam or sandy clay with a well developed but rather weak crumb structure which makes for good drainage and aeration, and this is underlain, usually at a depth of about 10 in., by a rather lighter coloured, well rooted sandy clay, rather more compact but still well drained and breaking up when disturbed into good angular crumbs. There is a gradual colour change to brownish-yellow throughout this horizon and at a depth of three or four feet the soil becomes reddish-yellow and faint red mottling may appear. At this depth the soil becomes considerably more compact and roots disappear. At 4 or 5 ft. a pink and white blotched horizon is developed which becomes increasingly white with depth and may show occasional red mottles with indistinct boundaries.

Fertility.

Analyses show rather low values for potash and phosphate but the good physical structure helps to give this soil a moderate degree of fertility which is above that obtainable from laterite soils having similar levels of available nutrients. Some erosion does occur even on the gentle slopes on which this soil is developed, but a ground cover under tree crops or planted food crops on the contour would be effective conservation measures. This soil appears

* Muck is used here to denote an organic soil which shows a loss on ignition of between 35 and 65 per cent.

to be suitable for most tree crops which do not make heavy demands on the soil nutrients, or for root vegetables, provided adequate dressings of organic manure are applied.

An example of rill erosion in an area which had been recently cleared preparatory to planting with young rubber is illustrated in Plate I. The slope does not exceed 5° but the volume of water during heavy rain is sufficient to cause severe erosion around the lower sections of the longer slopes and could eventually result in serious gullying unless preventative measures are taken.

Disturbed Land.

This includes all mappable areas in which the soil has been removed, as in the case of quarries, landing strips, dockyards etc., together with other areas in which the soil has been so altered by bulldozing, foundation laying, building of ammunition dumps etc., as to be rendered agriculturally useless. The type of soil which originally existed can usually be inferred from the surrounding soil pattern. Such areas are marked by the letters DIST on the field photographs and are coloured white on the map.

Jurong Clay and Fine Sandy Clay Loam. Series 9.

This heavy alluvial soil is found in the lower reaches of the main valleys. It generally merges with the Kranji Series on the downstream boundary, while on the upstream side there is a gradual change to soils of the Tengah Series. It is a moist soil with a high water table, which is particularly suited to vegetables, and most of the established leafy vegetable-growing areas are sited on this series.

Soil Profile.

A dark brown clay to fine sandy clay loam often with a good granular crumb structure and an organic matter content of about 10 to 20 per cent forms the surface soil, which usually continues to a depth of about 10 in. Below this there is a variable thickness of light brownish-grey, moist subsoil which changes with depth to a dark waterlogged zone with a strongly sulphurous odour. This latter horizon often has a rather higher organic matter content and may represent a buried Kranji series profile which has been covered by erosion material to form the topsoil. Occasionally the surface soil may lead directly into the dark organic zone without the development of any grey subsoil horizon; in such cases the watertable is generally within 12 or 18 in. of the surface.

Fertility.

This soil has a moderately high fertility and will grow most types of tree crops and vegetables. Potash values are quite high while phosphate is extremely variable. The land is usually very susceptible to flooding by fresh water during heavy rains and by brackish water during high tides, so that in many cases a combination of deep drains and tide gates would be necessary if complete protection is desired.

Most areas are under rubber, but vegetables are grown intensively around Kampong Ulu Pandan, and Plate II shows a typical garden in that district. Similar attempts by cultivators in the Lokyang area are hindered by the poor drainage conditions, and in many of the worst drained localities the soil is at present covered by thick scrub.

Kranji Fine Sandy and Silty Clays. Series 10.

These estuarine clay soils occur chiefly along the lower banks and at the mouths of the Kranji and Jurong river systems. They support a mangrove swamp vegetation under brackish water or marine conditions and, apart from a few coconuts, are not used for agriculture. Fish culture and collection of mangrove for firewood are the chief uses to which the land is put at present.

Soil Profile.

A dark brown silty or fine sandy clay topsoil up to 20 in. thick is underlain by a dark grey or black muck. This subsoil often shows marked variations in texture and organic matter content, and bands of coarse sand may be found interbedded with dark reddish-brown peat. Generally however the soil shows a loss on ignition of between 35 and 65 per cent and is therefore classed as muck. Decayed mangrove roots are the main source of this organic matter. The whole of the subsoil layer is waterlogged at high tide but drainage is good owing to the open texture of the muck. Profile examination down to 6 ft. is easily carried out during low tide.

Fertility.

Owing to the relatively high salinity, this soil in its present state is unsuitable for agriculture, and coconuts are the only crop which is grown in any quantity.

Reclamation of the swamps by bunding is unlikely to be worthwhile owing to the high cost in relation to the comparatively small areas which could be drained, and fish culture appears to be the most profitable occupation.

Lam San Sand. Series 22.

A thin, very poor, light coloured sandy soil occurring only in areas of level or nearly level topography along the inland edges of the mangrove swamps in the estuaries of the northern coast of the island. It is most commonly developed between the Kranji sands and clayey sands of the true swamp and either the Serdang or Peng Siang Series of upland soils.

The soil has been derived from an arenaceous parent material of Triassic age, but it is uncertain whether it has formed *in situ* from this or has accumulated at the foot of the slopes as a result of colluvial action. It is well drained in the upper horizons but waterlogging commonly occurs within 5 ft. of the surface owing to the fact that the soil is found mainly between 0 and 5 ft. above high tide level.

Soil Profile.

A topsoil of light brownish-grey or greyish-brown sand up to 3 in. thick is underlain by a lighter coloured sub-surface layer of pale grey or

light yellowish-brown sand which may continue to a depth of 20 in. Below this the subsoil is a pale yellow sand or sandy loam, compact but well drained. Root distribution shows a gradual decrease throughout this horizon and maximum rooting depth is normally about 50 in. A pale yellow clayey sand with reddish mottlings is developed in the lower layers of the subsoil and this appears to coincide with the normal level of the water table. Occasionally this mottled horizon is absent and in its place a dark grey waterlogged organic sand or clayey sand is found. Such composite profiles as this probably represent former Kranji Series soils which have been buried beneath a thick cover of colluvial sand; no differentiation has been made on the map between these two variations owing to their similar capabilities and the difficulty of distinguishing between them in the field.

Fertility.

This soil is highly leached in the upper horizons, while saline conditions may exist below the water table. It is strongly acid and has low potash-values while phosphate appears to be present in medium amount. Fertility is very poor, and coconuts are the only crop which grows fairly well; rubber is sometimes planted, while attempts are occasionally made to cultivate root vegetables, but with little success.

The soil occurs only on 'A' slopes.

Lokyang Clay Loam and Sandy Loam. Series 30.

This is a very poor, light coloured soil derived from Triassic shales of low iron content and rather variable textural composition. The profile is shallow and the parent material can usually be seen within 5 ft. of the surface. At the present time much of this soil is derelict and carries a very poor type of scrub. It occurs in a broad band which stretches in a north-westerly direction from the west bank of the Sungei Jurong estuary and runs beyond the present mapped area near the 15th milestone Choa Chu Kang Road. Relief is gently undulating to almost flat.

Soil Profile.

The surface soil is a light grey to greyish-brown clay loam or sandy loam up to 6 in. deep which contrasts markedly with the light coloured subsoil. After a few years under scrub and lalang (*Imperata cylindrica*) this topsoil develops a good granular structure, is well drained and aerated and appears to be ideal for cultivation. Unfortunately, however, this is not the case because after clearing the structure rapidly deteriorates and the small amount of fertility accumulated over a few years is soon lost. The appearance of this soil thus varies considerably and is a reflection of its recent cropping history. The subsoil is a rather compact, almost structureless light grey or pale yellow loam which is very difficult to dig. Roots are very rare, even at a depth of one foot below the surface, and the only apparent structure consists of large shrinkage cracks, and water movement is slow and takes place almost entirely along these cracks. At a depth of 3ft., faint yellow mottles or blotches may be apparent while the predominant colour of the

PLATE I.

(P.R.O., Singapore)

Rill erosion in a recently cleared area on Choa Chu Kang sandy loam.

PLATE II.

(P.R.O., Singapore)

A typical garden on Jurong clay loam.

PLATE III.

(P.R.O., Singapore)

Vegetable-growing on Lokyang clay loam.

PLATE IV.

(P.R.O., Singapore)

Erosion on a 7° slope in Malacca sandy loam.

soil changes gradually to white or, in some cases, a peculiar shade of greenish-white which does not appear on the Munsell soil colour chart. The parent material, which begins at a depth of 4 to 6 ft., often has a pronounced blocky structure due to fracturing along original bedding planes and red dendritic staining or mottling may be developed. No laterite is ever found in this soil.

Fertility.

The very low fertility is due to poor physical structure combined with low plant nutrient values; phosphate is present in small amounts while potash appears in medium quantities. The importance to vegetation of the dark organic topsoil layer is well illustrated in the analysis values for P_2O_5 and K_2O, both of which show a very rapid fall below a depth of 6 in. Erosion is not serious as the slope seldom exceeds 5° and is generally very much less. Run-off during heavy rain does however cause some damage on the few areas of 'B' slope which are planted out to vegetables.

The greater part of this soil is at present under scrub, although a little rubber is grown in some areas. Vegetable growing is carried out on a deep phase over 'A' slope to the south of Lokyang village, and Plate III shows a typical holding in that district. Very heavy manurial dressings are necessary to obtain reasonable yields and there are few other areas where even this standard of growth could be attained.

Two separate types, sandy loam and clay loam, can be recognised in the field, but owing to the rapidity with which they change no differentiation has been made on the map, and the series is best considered as a complex, the individual units of which could only be accurately plotted on a large scale.

Malacca Sandy Clay to Clay Loam. Series 24.

This soil series, first described by Owen (2) in 1951, has been identified in the present survey area, where it occurs over flat to strongly sloping land in the undulating country lying between the Bukit Timah hill range and the Choa Chu Kang hills. The parent material is an argillaceous rock of Triassic age but its exact nature is uncertain owing to the depth of weathering and general absence of exposures. It is a rather poor, shallow, lateritic soil of moderately heavy texture and its use capabilities are largely dependent on the depth of soil above the laterite band.

Soil Profile.

A yellowish-brown or dark greyish-brown sandy loam an inch or two thick is underlain by a sandy clay or clay loam which shows a gradual colour change with depth from yellowish-brown to brownish-yellow. This subsoil horizon varies in thickness from about 1 to 2½ ft., is well drained and aerated and breaks down to give a good angular crumb structure. The upper part of this horizon is generally well rooted. A rapid change to laterite then occurs, the irregularly shaped ironstone concretions, which vary in size up to 1½ in., often being cemented together to form large rough boulders. The matrix is a brownish or reddish-yellow sandy clay or clay loam. The laterite

is normally about 18 in. thick and is underlain by a compact reddish-yellow sandy clay which becomes increasingly stained with red mottles towards the base of the profile.

Fertility.

The soil has a strongly acid reaction, and is low to very low in both phosphate and potash. The fertility is rather variable and appears to be related to the available root room combined with the thickness and organic matter content of the topsoil layer, and thus varies according to the amount of erosion which has taken place. As the original topsoil represents the accumulated fertility of years under natural forest its conservation should be an important factor in the farming of such soil. Unfortunately, clean weeding in the past has caused serious damage over many areas. Clean weeded rubber is still seen in places, and the exposed root systems of many trees prove that erosion has occurred in fairly recent times.

Rubber and fruit trees are the most important crops growing on this soil, but it is occasionally planted out to Type B vegetables (see page 24). Cover cropping under tree crops and planting of vegetables along the contour are obvious precautions which should be taken. Widespread vegetable growing on this soil is unlikely however because of the general absence of an adequate water supply.

Plate IV shows Class 2 erosion on a 7° slope. The roots of the rubber trees stand well above the present soil surface and the only ground cover consists of leaves which have accumulated during a recent fall.

Peng Siang Sandy Loam and Fine Sand. Series 26.

This soil is similar to the Malacca clay loam but differs in having a rather thinner concretionary band which is formed at a greater depth below the surface. It has also a slightly lighter texture which results in easier subsoil drainage and it is this physical difference which probably accounts for the deeper development of the laterite. It has a scattered distribution in undulating country throughout the mapped area and often occurs in close association with soils of the Malacca Series.

Soil Profile.

A well drained, well rooted surface horizon of greyish-brown sandy loam or fine sand up to 8 in. thick is underlain by a brownish-yellow loam or sandy loam possessing a weak subangular crumb structure. This subsoil is usually about 4 ft. thick and overlies a laterite band made up of small, closely packed, irregularly shaped red ironstone concretions which may be cemented together forming large angular blocks. The laterite is between 1 and 18 in. thick and normally occurs at a depth of about 5 ft. The concretionary zone has a well demarcated upper and lower boundary and is underlain by a reddish-yellow sandy clay which shows a gradually increasing amount of red mottling with depth.

Plate V, taken in a recently worked quarry, illustrates a typical Peng Siang sandy loam profile in which the laterite band can be clearly seen running parallel to the surface some 6 in. below the bottom of the auger.

PLATE V.

(P.R.O., Singapore)

Peng Siang sandy loam profile showing laterite band.

PLATE VI.

(P.R.O., Singapore)

Vegetable-growing on a 14° slope on Rengam sandy clay loam.

PLATE VII.

(P.R.O., Singapore)

Seriously eroded 'C' class slope on Ulu Pandan silty clay.

Analysis shows that the values for available plant nutrients in this soil correspond closely to those for the Malacca Series. The greater fertility which can be noted in the field is undoubtedly due to better physical properties, the most important of which is the greater root room resulting from the greater depth of laterite. This, together with the improved structure resulting from the lighter texture, makes for improved aeration and better drainage in the subsoil. Phosphate appears to be the most seriously deficient nutrient. Erosion does not take place on this soil so readily as on the Malacca Series nor are its consequences so serious.

Rubber is grown over the greater part of this soil and reasonable yields can be expected under good management; much of the present rubber however is very old and hopelessly neglected. Fruit is grown south of Kampong Ulu Pandan and root vegetables are cultivated by smallholders in many widely scattered areas. Water supply is the limiting factor where vegetable growing is concerned, and this reduces the potential sites to the immediate vicinity of the larger streams. Two soil types have been identified and mapped during the survey, namely the Peng Siang sandy loam, marked by the symbol 26 on the aerial photographs and soil map, and the Peng Siang fine sand which is a rather better structured, freer-draining soil mapped with the symbol 26a.

Rengam Sandy Clay Loam. Series 61.

This granite soil occurs over a small area of strongly undulating and hilly country in the north-east corner of the surveyed area. It is a deep, well structured and well drained non-lateritic soil which was first described by Owen (2) in 1951. It has a wide distribution throughout Malaya, and the greater part of the granites which are found in the centre of Singapore Island appear to be covered by this soil type.

Soil Profile.

A dark brown or greyish-brown sandy clay loam with a well developed granular crumb structure is characteristic of the topsoil and this changes gradually, at a depth of about 6 or 8 in., to a reddish-yellow, well structured and well drained subsoil which has all the appearances of a good rooting medium. This subsoil horizon is normally at least 4 ft. thick and, apart from a slight compaction at depth, shows a remarkable uniformity and roots are often well distributed even as far down as 5 ft. Below this there is a gradual change to a more compact pale red sandy clay loam.

Fertility.

A combination of good physical properties with moderate plant nutrient values helps to make this one of the more fertile of the Malayan soils. Phosphate reserves are rather low however and nitrogen is usually in short supply. Gullying can, and often does occur on the steeper slopes in some of the larger smallholding areas which are cleared of surface vegetation by pigs and poultry kept under fruit trees.

The small area shown on the map is mainly under lalang with a little rubber and some fruit trees, but in other parts of the island this same soil

is under intensive cultivation by smallholders who produce both leaf and root vegetables. A very high standard of conservation farming is practised by these peasants and soil movement is reduced to a minimum by contour cropping. Water supply is often a problem in times of drought, and run-off is directed into cement-lined storage ponds laboriously dug in the hillsides in which water hyacinth is grown for pig feed. Even 'D' slopes are cultivated in this manner and Plate VI shows a typical area. The beds shown in the foreground are constructed on a 14° slope.

This soil can be safely recommended for vegetable growing provided good conservation farming methods are practised; unfortunately however the greater part occurs within the Municipal Catchment Area and is not available for general agriculture.

Serdang Sandy Loam to Sandy Clay Loam. Series 27.

This soil has a wide distribution north of the Choa Chu Kang Road where it occurs in gently and moderately undulating country. It is deep and well drained and exposures of the parent rock, which probably varies from a fine Triassic sandstone or quartzite to a coarse conglomerate, are uncommon and some difficulty may be experienced in distinguishing certain phases of this soil from those developed over fine-grained granites.

Soil Profile.

A dark greyish-brown sandy loam two or three inches thick changes gradually to a strong brown or brownish-yellow sandy loam or sandy clay loam subsoil which extends to a depth of 4 to 5ft. This horizon is well drained and aerated and usually has a good root distribution; it is loose and easy to dig and breaks down into weak subangular crumbs. A gradual colour change to reddish-yellow and perhaps even yellowish-red then takes place over the next two to three feet while at the same time roots decrease rapidly in number and the soil becomes rather heavier textured and compact. Red mottling may be developed at a depth of 5 to 6 ft. in some profiles and probably occurs in all soils of this series at rather deeper levels.

Fertility.

The fertility is moderate to good and analysis indicates rather variable and often quite high values for potash with low to very low available phosphate contents. Erosion damage is not serious in the present area, but gullying is always a danger on the steeper slopes where clean cultivation is practiced. Soil deterioration as a result of exposure of the surface layer is rather widespread.

Rubber is the chief crop but fruit trees, including papaya and banana, coconuts and root vegetables are all grown with a variable degree of success. However, the free draining character of the soil, which results in rapid drying of the topsoil horizons makes vegetable growing a risky undertaking even during short droughts, and for this reason it is unsuitable for vegetables except in low lying positions near a dependable water supply.

Sungei Kadut Clay to Sandy Clay Loam. Series 65.

A rather poor, thin, lateritic soil with a variable profile which is found over the gently and moderately undulating country to the west of the Bukit Timah Road, north of Bukit Panjang village. The parent material is probably a basic rock of norite type.

Soil Profile.

A thin, greyish-brown clay to sandy clay surface soil is underlain by a strong brown or brownish-red subsoil which changes to a reddish laterite at a depth of between 18 and 36 in. This is often very thick and consists of concretions of various sizes from small pebbles up to large boulders. Bauxite, which can be distinguished by its whitish colour, often occurs with the laterite, and old bauxite workings can be seen on some hill tops.

Fertility.

The fertility largely depends on the depth at which the concretions are developed and erosion, which has been serious in some places, may result in exposure of the laterite on the surface. Available potash and phosphate values are low and although fruit trees appear to do well, it is unlikely that other crops could be grown with much success, except on the deeper phases. It is not a good soil for leaf vegetables.

This soil has probably developed from the same parent material as the Bukit Panjang Series and its differences are due to the different topography. The Bukit Panjang Series is a young soil developed on the steeper hills where geologic erosion is more rapid and the parent rock occurs within a few feet of the surface, while the shallow lateritic Sungei Kadut Series represent a senile phase derived from this same material but formed over very much shallower and older slopes where the process of laterisation has been at work for a considerable period of time.

Tengah Fine Sandy Clay Loam, Clay and Clayey Sand. Series 8.

This is an alluvial soil, derived chiefly from Triassic sediments, which is found in the valley bottoms. It is more common in the valleys of the northern flowing streams than in the broad flat valleys on the south side of the island, the latter being mostly covered with soils of the Jurong Series. The soil is fertile and suitable for most crops. It is only found in flat or nearly flat areas and does not suffer from erosion. Drainage is moderate in the upper horizons while waterlogging frequently occurs at a depth of 2 ft.

Soil Profile.

The surface soil is a dark brown or dark greyish-brown fine sandy clay loam, clay or clayey sand, normally well rooted and with a good granular crumb structure continuing to a depth of 8 in. This is underlain by a lighter, brownish subsoil with good structure and reasonable aeration and drainage which continues down to a depth of about 20 in. A grey or light-grey compact waterlogged horizon is then found in which roots have practically disappeared. At a depth of between 4 and 6 ft. this changes to a light olive-brown or bluish-green highly compact horizon of sandy clay which marks the zone of permanent saturation.

Fertility.

This is a fertile soil with good physical and chemical properties. Analysis of available nutrients shows medium to high values for potash and rather variable but occasionally quite high values for phosphate. Rubber and fruits do well on this soil, while it is also suitable for both leaf and root vegetables. Unfortunately however, most of it is at present under tree crops, and only small areas are available for market gardening.

Three separate soil types have been recognised during the survey, the most widespread of these being the fine sandy clay loam, marked on the aerial photographs with the symbol 8, and generally the most suited of the three for market gardening on account of its easy working texture combined with moderate topsoil drainage. The second type, marked as 8a, is a rather heavy clay soil which has a patchy distribution within the first type and is not normally present in mappable quantities. The third type, shown as 8b, is a lighter textured clayey sand which on account of its freer draining topsoil may be unsuitable for leaf vegetables in the absence of a reliable water supply.

The occurrence of these soils in valley bottoms usually means that stream water is available within a short distance and, except in the case of Class 3 streams, the supply is generally adequate for most types of vegetables,

Ulu Pandan Silty Clay and Fine Sandy Clay. Series 29.

This is a heavy, red lateritic soil which occurs in moderately undulating to hilly country. The parent material is an iron-rich, dark reddish coloured shale of Triassic age which is often used in the manufacture of earthenware. Subsoil drainage is poor and during heavy rains the surface run-off may result in heavy erosion. Various types of tree fruits and poor rubber are the main crops grown at the present time, the fruit being cultivated chiefly by smallholders living on the large area of Crown Land south of Kampong Ulu Pandan. The soil is also found north of this village, where it continues as a broad band stretching north-west to Lam San village on the Choa Chu Kang Road. Another large area, mostly under rubber, is found east of the Lim Chu Kang Road near Ama Keng village.

Soil Profile.

The surface is a reddish-brown, moderately well structured silty clay to fine sandy clay 2 to 3 in. thick where uneroded, and changing gradually to a slightly lighter shade of reddish-brown in the sub-surface layer, which normally extends to a depth of about 8in. The red subsoil, of similar texture, is compact but may display large vertical shrinkage cracks which are closely followed by plant roots. The laterite horizon, which begins at a depth of 15 to 30 in., is made up of closely packed, small, rounded ironstone concretions between ¼ and 1 in. in diameter embedded in a matrix of red clay. This laterite band may be up to 3 ft. thick and the size of the individual concretions often increases with depth to a maximum size of 4 in. Roots are rarely seen at this level and the top of the laterite band normally indicates the effective rooting depth. The laterite is underlain by compact, dusky-red,

Table I.

SOIL CHARACTERISTICS.

Important Field Characteristics.

Map Symbol. (1)	Series. (2)	Dominant Slope Range. (3)	Drainage Through the Soil. (4)	Moisture Supplying Capacity. (5)	Layer Limiting Root Penetration. (6)	Normal Rooting Depth. (7)	Erosion Hazard. (8)	Natural Fertility. (9)
31	Aik Hong coarse sandy loam.	C (B)	Good	Poor	Compact subsoil	4 ft.	High	Very poor
28	Ayer Terjun clay to sandy loam.	C (B)	Poor	Poor	Parent material	2 ft.	High	Extremely poor
64	Bukit Panjang clay to sandy clay loam.	C and B	Good	Moderate	Parent material	6 ft.	Very slight	Moderate to good
64a	Bukit Panjang stony clay to stony sandy clay loam.	C, D and B	Good	Poor	Parent material	3 ft.	Slight	Moderate
124	Bukit Susop stony loam.	C and D	Moderate	Poor	Stony subsoil	6 in.	High	Extremely poor
11	Chew Boon Lay muck.	A	Moderate above, waterlogged below.	Good	High water table	20 in.	Nil	Moderate
26b	Choa Chu Kang sandy loam to sandy clay.	B	Good	Moderate	Compact subsoil	5 ft.	Moderate	Moderate
9	Jurong clay and fine sandy clay loam.	A	Poor above, waterlogged below.	Good	High water table	2 ft.	Nil	Moderate to good
10	Kranji fine sandy and silty clays.	A	Moderate	Good	Low tide level	6 ft.	Nil	Very poor
22	Lam San sand.	A	Good above, waterlogged below.	Good	High water table	50 in.	Nil	Very poor
30	Lokyang clay loam and sandy loam.	B (A)	Poor	Poor	Compact subsoil	1 ft.	Slight	Extremely poor
24	Malacca sandy clay to clay loam.	A and B (C)	Moderate	Poor	Laterite	3 ft.	High	Very poor
26	Peng Siang sandy loam and fine sand.	B (C)	Good	Moderate	Laterite	3–7 ft.	Slight	Moderate
61	Rengam sandy clay loam.	B and C (D)	Good	Moderate	Compaction with depth	10 ft.	High	Moderate to good
27	Serdang sandy loam to sandy clay loam.	B (C)	Good	Moderate to poor	Compaction with depth	5 ft.	Moderate	Moderate to good
65	Sungei Kadut clay to sandy clay loam.	B (C)	Moderate	Poor	Laterite	3 ft.	High	Poor
8	Tengah fine sandy clay loam, clay and clayey sand.	A	Moderate above, waterlogged below.	Moderate	High water table	2–3 ft.	Nil	Moderate to good
29 & 29a	Ulu Pandan silty clay and fine sandy clay.	B and C (D)	Poor	Moderate	Laterite	30 in.	High	Very poor

Table II.

SOIL CHARACTERISTICS.

Position, Parent Material and Profile Features.

(a) **Soils on Flat Land.**

Physiographic Position	Series	Map Symbol	Parent Material	Surface Soil			Subsoil			
				Colour	Consistency	Thickness	Colour	Consistency	Texture	Thickness
						in.				
Valley bottoms	Jurong	9	Recent alluvium from Triassic sediments	Dark brown	Good granular	10	Brownish-grey	Compact	Clay to fine sandy clay	2 ft.
Valley bottoms	Tengah	8	Recent alluvium from Triassic sediments	Dark brown	Granular	8	Light brown	Granular	Fine sandy clay loam	20 in.
Edge of estuarine flats	Lam San	22	Sandy Triassic	Light grey	Loose	3	Light yellow	Compact	Clayey sand	4 ft.
Large inland flats	Chew Boon Lay	11	Recent organic deposit	Dark brown	Loose	20	Dark reddish-brown	Loose	Muck	6 ft.
River estuaries and coastal swamps	Kranji	10	Recent alluvium	Dark brown	Granular	10	Black	Granular crumb	Muck	6 ft.

(b) **Soils on Sloping Land.**

Strongly undulating steep hilly	Bukit Susop	124	Argillaceous Triassic	Brown	Moderate friable	less than 6	Strong brown	Compact	Stony loam	3 ft to parent material
Undulating to hilly	Bukit Panjang	64	Norite	Dark reddish-brown	Very friable	6	Reddish-brown to red	Very friable	Clay to sandy clay loam	4 ft.
Undulating to hilly	Bukit Panjang (Stony)	64a	Norite	Reddish-brown	Very friable	1	Red	Friable	Sandy clay to loam	2 ft.
Undulating to hilly	Rengam	61	Granite	Dark brown	Friable	10	Reddish-yellow	Friable	Sandy clay loam	4 ft. +
Strongly undulating	Aik Hong	31	Arenaceous Triassic	Grey	Very weak friable	6	Reddish-yellow	Compact	Coarse sandy loam	4 ft.
Moderately undulating to hilly	Ulu Pandan	29 & 29a	Iron rich Triassic shale	Reddish	Friable	8	Red	Compact	Silty to sandy clay	2 ft. to laterite
Undulating	Ayer Terjun	28	Argillaceous Triassic	Reddish-brown	Friable	2	Red	Compact	Clay to sandy loam	2 ft. to parent material
Undulating	Peng Siang	26	Argillaceous Triassic	Greyish-brown	Friable	8	Brownish-yellow	Friable	Loam or sandy loam	4 ft. to laterite
Undulating	Sungei Kadut	65	Norite	Greyish-brown	Hard	2	Brownish-red	Compact	Clay to sandy clay loam	3 ft. to laterite
Gently to moderately undulating	Serdang	27	Arenaceous Triassic	Dark brown	Weak friable	4	Brownish-yellow	Weak friable	Sandy clay loam	5 ft.
Gently undulating	Choa Chu Kang	26b	Triassic	Yellowish-brown	Friable	10	Brownish-yellow	Weak friable	Sandy clay to sandy loam	5 ft.
Gently undulating	Lokyang	30	Iron poor Triassic shale	Light grey	Granular	6	Pale yellow	Compact	Sandy loam to clay loam	4 ft. to parent material
Almost flat to moderately undulating	Malacca	24	Argillaceous Triassic	Yellowish-brown	Loose friable	2	Brownish-yellow	Subangular blocky	Sandy clay to clay loam	3 ft. to laterite

silty clay or shale at a depth of 4 to 5 ft., which is the top of the parent material horizon.

Fertility.

The soil is very strongly acid and the fertility is poor. Phosphate values are low to very low and phosphorus is probably the most seriously deficient nutrient. The soil is very easily eroded and complete loss of topsoil, and even subsoil down to the laterite horizon, is an all too common feature.

In the past, the practice of clean weeding rubber has probably been responsible for much of the erosion in this soil, and a similar practice which is carried on at the present day by smallholders is causing very serious soil loss under fruit trees. The ground beneath the trees is normally kept clear of vegetation by overstocking with poultry and the bare soil is rapidly removed by surface run-off until the laterite horizon is finally exposed. Plate VII shows a seriously eroded 'C' slope in this soil; complete Class 3 erosion has taken place here and the ground surface consists of a red laterite gravel. The trees, which appear surprisingly healthy considering the nature of their rooting medium, obtain their nutrient from what is little more than parent rock. The need for a cover crop is obvious on all slope phases of this soil, for even on gentle slopes of between 2 and 5°, where the erosion menace is not so great, the fertility is rapidly reduced by oxidation of organic matter in the thin topsoil layers. The growing of annual crops should be avoided and only tree crops, such as fruit or rubber, which make smaller demands on the soil nutrients and protect the structure can be expected to grow with any degree of success.

Two soil types have been recognised and mapped, the symbol 29 being used for Ulu Pandan silty clay and 29a for the slightly less heavy textured fine sandy clay. This latter type differs from the more widespread silty clay in being slightly better drained and in having a thinner laterite horizon developed at greater depth.

Tables of Soil Characteristics.

A summary of more important features of the above soils is given in Tables I & II. Table I includes the more important land use factors while Table II summarises the main profile features.

PART III. Suitability Tables.

1. Type A Vegetables.

Type A vegetables include most leaf vegetables, the snake gourd, bitter cucumber, and one or two salad vegetables, including lettuce.

Class I: Level or nearly level, uneroded, well watered alluvial soils which, when properly drained, are generally suitable for Type A vegetables.

Tengah fine sandy clay loam.
Tengah clay.
Jurong clay to fine sandy clay loam.
Chew Boon Lay muck.

Class II: Less suitable than Class I but if adequate water is available can be used to grow Type A vegetables on the shallower slopes, and in some cases also on steeper slopes provided great care is taken to prevent erosion.

Tengah clayey sand.
Peng Siang sandy loam.
Peng Siang fine sand.
Rengam sandy clay loam.
Serdang sandy loam to sandy clay loam.
Choa Chu Kang sandy loam to sandy clay.

Class III: Soils which are unsuitable for Type A vegetables.

Kranji silty to fine sandy clays.
Ayer Terjun clay to sandy loam.
Ulu Pandan silty clay.
Bukit Susop stony loams.
Lam San sand.
Lokyang sandy loam.
Bukit Panjang clay to sandy clay loam.
Bukit Panjang stony clay to stony sandy clay loam.
Sungei Kadut clay to sandy clay loam.
Malacca sandy clay to clay loam.

2. Type B Vegetables.

Type B vegetables include most salad and fruit vegetables, peas and beans, tomatoes, gourds and pumpkins, and the tuberous vegetables. Many of these crops grow well on alluvial soil provided it is well drained, but such areas are generally planted with Type A vegetables which are capable of bringing a higher return per acre.

Class I: Level or nearly level soils which, if well drained, are suitable for Type B vegetables.

Tengah fine sandy clay loam.
Tengah clay.
Tengah clayey sand.
Jurong clay to fine sandy clay loam.
Chew Boon Lay muck.

Class II: Hill soils having one adverse soil factor such as thin topsoil, poor fertility or rapid drainage but can be used provided measures are taken to prevent erosion.

Rengam sandy clay loam.
Peng Siang sandy loam.
Peng Siang fine sand.
Malacca sandy clay to clay loam.
Choa Chu Kang sandy loam to sandy clay.
Serdang sandy loam to sandy clay loam.
Sungei Kadut clay to sandy clay loam.

Class III: Soils which are unsuitable for Type B vegetables.
Lam San sand.
Kranji silty to fine sandy clay.
Ayer Terjun clay to sandy loam.
Ulu Pandan silty clay and fine sandy clay.
Bukit Panjang clay to sandy clay loam.
Bukit Panjang stony clay to stony sandy clay loam.
Bukit Susop stony loams.
Lokyang clay loam to sandy loam.

PART IV. Summary and Conclusions.

The most important fact emerging from this survey is the poor fertility of the great majority of the soils, and the investigation has led the writer to conclude that the three main factors responsible for this state are:-

(a) the low nutrient levels of the soils,
(b) the generally poor physical structure, and
(c) the serious erosion and degradation which has resulted from interference by man.

The chemical analyses which have been carried out on the samples from the test pits, while they are by no means exhaustive, are sufficient to enable a number of interesting conclusions to be drawn. The most obvious feature is the low available phosphate value shown by almost all the hill soils, including those derived from basic rocks, and phosphate certainly appears to be the most seriously deficient nutrient. The alluvial soils show slightly higher phosphate contents but there is little doubt that here again phosphate is the limiting factor. Potash values indicate medium to low amounts in both Triassic and Igneous derived soils, and occasional quite high quantities in the alluvial series. Nitrogen values are closely related to the organic matter contents of the soils and show a wide variation both between the various series and within each series depending on recent cropping history and degree of erosion.

Physically, the chief adverse factor in the alluvial soils is the high water table which brings about restrictions in root room for deep rooting crops, a feature which does not hinder the growth of vegetables, and several areas at present under rubber could be more usefully cultivated in this manner.

The most important physical hindrance to good plant growth in the hill soils is restricted root room due to laterite development in the heavier textured soils derived chiefly from argillaceous Triassic rocks. In other instances shallow subsoils result from the closeness to the surface of the parent material, which is sufficiently compact to prevent the entry of plant roots. Such is the case with the Lokyang and Bukit Susop Series.

The Rengam and Bukit Panjang Series are two soils which contrast markedly with the other types in having unusually good crumb structure and deep, well drained and aerated subsoils.

Evidence of erosion in the past is only too obvious on a great number of the soils. The consequences have been most serious on the lateritic types together with the shallow non-lateritic Bukit Susop and Lokyang Series.

In addition, deterioration resulting from oxidation of the organic matter in the topsoil, caused by over exposure, has also played its part in destroying the soil's natural fertility.

Among the practices which have brought this erosion about are the former wide-scale cultivation of gambier, the growing of pineapples on the hill soils, clean weeding in rubber, and over-stocking of the land with poultry or pigs. This last practice, which results in complete removal of all vegetation and rapid erosion of the bare topsoil, is very widespread at the present day, and active erosion on such land can generally be observed with little difficulty. The more general use of cover crops and the introduction of simple mechanical conservation measures could do much to arrest erosion in many of the present cultivated areas, but other areas, which should never have been used for agriculture, are already ruined and now lie derelict.

Acknowledgements.

The writer wishes to express his grateful thanks to Mr. J. W. Ewart, of the Botanic Gardens, Singapore, Mr. A. Robb, former Food Production Officer, Singapore, and Mr. T. Cobb, Agricultural Officer, Singapore, for the information and assistance which they so freely gave, also to Mr. R. B. Jagoe, Chief Research Officer, Mr. J. K. Coulter, Acting Senior Chemist (Soils), and Mr. G. W. Arnott, Chemist (Soils), of the Department of Agriculture, Federation of Malaya, for their helpful criticism and advice.

References.

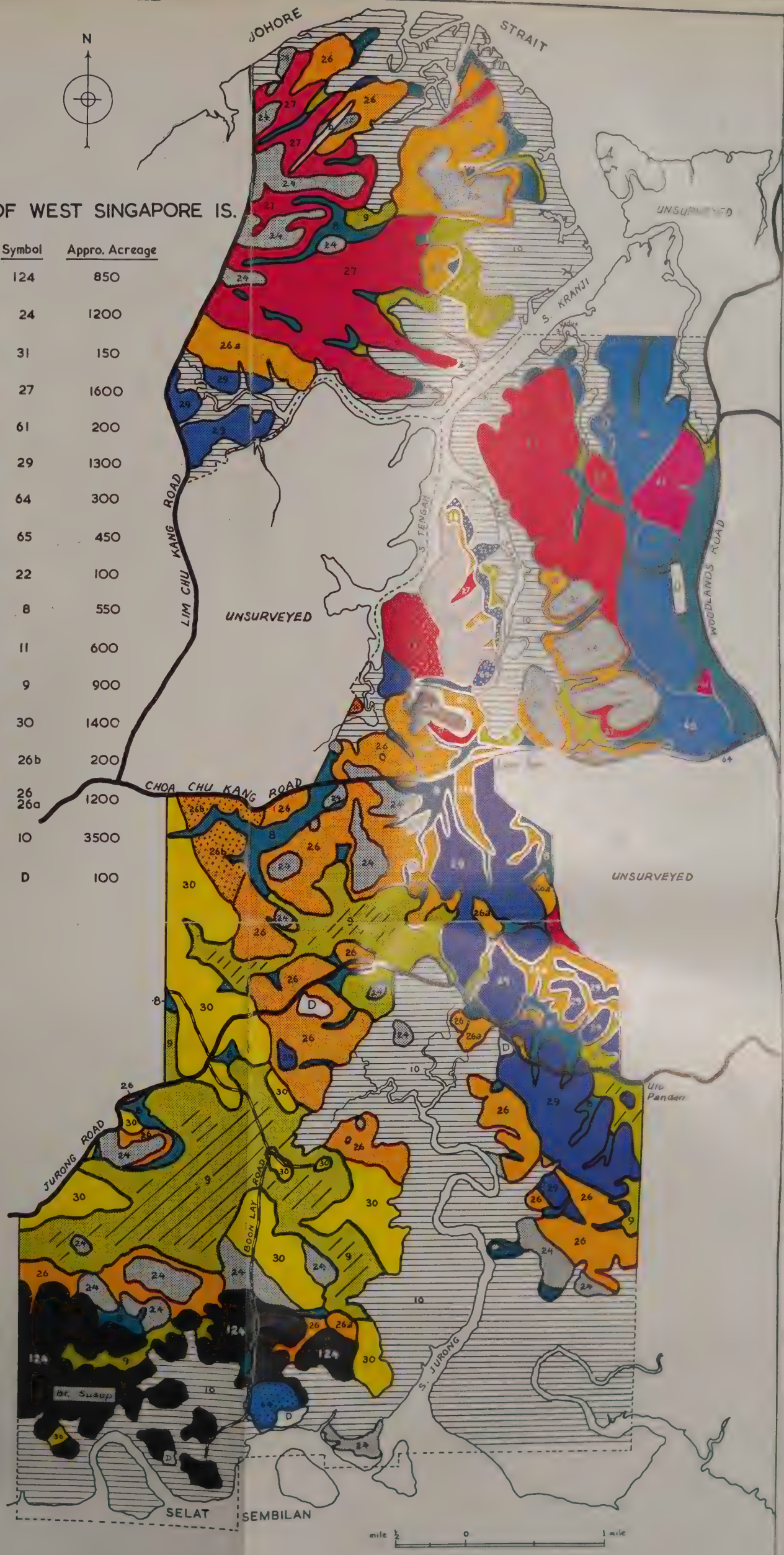
(1) Alexander F.E.S. (1950): Report on the Availability of Granite on Singapore and the Surrounding Islands. Government Printing Office, Singapore, 1950.

(2) Owen G.A. (1951): "A Provisional Classification of Malayan Soils." *J. Soil Sci.*, **2**, 20.

SOIL MAP OF A PART OF WEST SINGAPORE IS.

Soil Series	Colour	Symbol	Appro. Acreage
Bukit Susop		124	850
Malacca		24	1200
Aik Hong		31	150
Serdang		27	1600
Rengam		61	200
Ulu Pandan		29	1300
Bukit Panjang		64	300
Sungei Kadut		65	450
Lam San		22	100
Tengah		8	550
Chew Boon Lay		11	600
Jurong		9	900
Lokyang		30	1400
Choa Chu Kang		26b	200
Peng Siang		26 26a	1200
Kranji		10	3500
Disturbed Land		D	100

Basic information from maps by the Survey Department, Malaya, has been incorporated in this map with the permission of the Surveyor General.



INVESTIGATIONS INTO THE MECHANICAL COLLECTION AND BALING OF PADI STRAW DURING THE 1953-54 HARVEST

BY

D. M. HAYNES,

Agricultural Engineer I

Introduction.

Padi straw is collected, dried and stored in areas where buffaloes are common (2), but on many smallholdings the straw and stubble is burnt off after harvest or slashed and trampled down to encourage rotting (1). It is unusual for cultivators who do not own livestock to sell their straw but this apparent lack of enterprise is probably largely due to the difficulty of collecting and transporting the material, because it has a potential market for both agricultural and industrial uses.

There is always a demand from Agricultural Stations for straw for making farm-yard manure and for other purposes, and it was decided that mechanical methods of handling straw should be investigated during the 1953-54 harvesting trials. The objects of this investigation were:-

(i) to test conventional equipment of the type used in other countries to determine whether it could deal satisfactorily with padi straw under Malayan conditions,

(ii) to determine the cost of collecting, baling and handling straw, and

(iii) to provide baled straw for use on Agricultural Stations.

Tests with stationary balers were made in Kedah, Kelantan and Negri Sembilan. In Kedah, the straw was collected by a tractor-mounted buckrake, but in the other States hand labour was used for collection.

Description of Implements and Machines.

TRACTOR-MOUNTED BUCKRAKE.

Lack of funds precluded the purchase of a commercial buckrake, and it was decided that an old hay-sweep should be renovated and modified. This hay-sweep, which was purchased in 1948 for work on pasture experiments, was a front-mounted implement designed for use with the Farmall "A" tractor. It was not equipped with a hydraulic lift and the weight of the implement and its load was carried on a pair of castor wheels, which were considered to be too small for padi field conditions. These wheels, and the beams used to attach the implement to the Farmall "A", were discarded and the rest of the framework, consisting of the wooden tines with cast iron tips and the side and rear frames, was stripped, checked and reassembled. A new rear member, which could be attached to the three-point linkage of a Ferguson tractor, was bolted to the rear frame and a pair of simple legs

were fitted to hold the implement at a convenient height for hitching and unhitching. The buckrake was given four coats of paint to protect the timber from the weather but the condition of the tines was poor because of deterioration in storage. Three of the original tines broke during the tests and had to be replaced with substitutes made from local *meranti* timber: this timber was not resilient and the tines made from it had a very short life. It is probable that *tempenis* (a timber used for changkol handles and similar duties) would have been more satisfactory, but no long pieces of this wood were obtainable.

The Opperman Light-Weight Baler.

An Opperman Light-weight Baler was obtained from the United Kingdom during 1953. It weighs approximately 19 cwt. and is 18 ft. 6 in. long. The Baler is mounted on a pair of wheels with 16 x 4 pneumatic tyres and the rear of the baling chute is extended to form a drawbar*. The Baler can be towed by a tractor or by a Land Rover but it must be unhitched and the drawbar supported by the stand provided before work can commence.

The Opperman Baler is of conventional design: it consists of three basic units, the drive mechanism, the baling chamber, and the baling chute, built on a chassis of mild steel angles. The drive mechanism is mounted at the front of the chassis and consists of a 6 h.p. Douglas four-stroke, air-cooled petrol engine, a counter-shaft, a large flywheel and a reduction gear. The drive is taken from the engine to the counter-shaft and from the counter-shaft to the flywheel by multiple Vee-belts, and all the units are bolted to slotted holes in the frame so that the tension of the various belts can be adjusted.

The baling chamber is in the centre of the frame and is built up from mild steel plates. The straw is forced down into the chamber by the packer, to which the main drive imparts a vertical reciprocating movement: the linkages of the drive are spring-loaded to prevent damage should the packer strike an obstruction. The straw in the baling chamber is compressed into bales by the ram, which slides backwards and forwards within the chamber and is synchronised with the packer. The timing of the ram and packer drives is arranged to allow the maximum possible time for loading loose straw into the chamber and the minimum for the compression stroke. For normal working, a speed of 15 to 20 strokes per minute is satisfactory: the Baler runs steadily and there is ample time for feeding in straw at this speed.

The baling chute is attached to the rear of the baling chamber. The straw is forced into the chute by the ram and the friction of straw against the top and bottom slides provides the resistance to movement which allows the ram to compress the straw into compact bales. The ends of the chute are joined by a pair of bolts and compression springs and the density of the

* In the majority of pick-up farm balers now in use the engine or drive mechanism is at the front of the machine and the baling chute at the rear, so that the bales can be dropped as the machine moves forward. In describing the stationary balers in this article the drive mechanism is therefore considered as the front of the machine even though this results in the apparent anomaly of the drawbar being at the rear. The terms recommended in British Standard 2468: 1954, "*Classified Glossary of Terms relating to Agricultural Machinery and Implements*", are used, where applicable, in describing machines and implements.

bales can be increased by tightening these springs, thus increasing the friction between the straw and the slides.

Tying of the bales is carried out while they are in the baling chute. The Opperman Baler was not equipped with the optional semi-automatic tying device and the bales were tied by hand. To facilitate hand tying, special wooden dividing boards are dropped into the baling chamber at appropriate intervals to separate the individual bales as they pass along the baling chute. On either side of the dividing boards are deep grooves through which the baling twine can be passed with a special needle: the twine is pulled tightly around the bale and knotted. Each bale is tied by two bands of twine.

No modifications were made to the mechanism of the Opperman Baler, but the wheels were considered to be too small for padi field conditions and the axle was discarded and replaced by an old Jeep trailer axle fitted with 6.00 x 16 tyres. The ignition system of the Douglas engine had been damaged by exposure in transit and was never satisfactory: the magneto and wiring were eventually replaced. The governor and its associated linkage also gave trouble and required frequent attention. The counter-shaft bearing seized up after a few hours running and it was found that the grease-ways were blocked; no further seizures were experienced after the bearings had been thoroughly cleaned but they continued to run very hot.

The Nicholson Light Baling Press, Type BP 1.

A Nicholson Baling Press was purchased during 1953 by the State Agricultural Officer, Negri Sembilan. This machine is of a similar type and size to the Opperman Light-weight Baler but is specially adapted for tractor power-take-off drive and is fitted with a semi-automatic tying device.

The power-take-off drive is arranged by attaching a long, telescopic shaft with two universal joints to the counter-shaft of the Baling Press. The tractor stands at right angles to the Baling Press, and the drive shaft, which is provided with a pair of universal joints, is connected to the power-take-off shaft by a suitably splined socket. The drive is taken from the counter-shaft to the flywheel by multiple Vee-belts and thence to the main drive by a pair of reduction gears. The packer and ram, the baling chamber and chutes and the device for controlling bale density are similar to those of the Opperman Baler.

Dividing boards and needles are supplied with the Nicholson Baling Press and can be used for normal hand tying of bales, but an optional semi-automatic tying device was fitted to the machine in question. This device consists of a pair of long hooks or "needles" joined together by a handle, a "needle" guide and a string retaining mechanism. The ends of two balls of twine are threaded into the string retainer under a spring-loaded bar which adjusts the twine tension: the retainer is then raised by pressing a pedal on the operator's side of the machine and is held up by a simple catch. When the bale has reached the desired size the feeders stop for a few seconds and the operator then pushes the "needle" along its guide into the baling chamber. On its next stroke the ram pushes the "needle" backwards so

that it trips a lever connected to the catch which holds the string retainer; the retainer falls, dropping the twine into the hooks on the "needle", which is then withdrawn, taking two loops of the twine with it. The feeders then start work again, the operator cuts the twine at the appropriate length, ties the knots by hand and presses the pedal to lift the string retainer ready for the next cycle.

Field Trials.

The initial trials of the buckrake and the Opperman Baler were carried out in Kedah by personnel from the Federal Experiment Station, Serdang, under the supervision of the writer. After the best methods of organising the work had been found and the machines used for a few days in order that costs might be recorded, they were handed over to the local staff who continued routine work for about four weeks. In February, the Opperman Baler was sent to Kelantan where it was used by the local staff. The Nicholson Baling Press was used in Negri Sembilan and was also operated by local personnel.

Collection of Straw.

The tractor-mounted buckrake was used to collect straw in Kedah but breakage of the tines prevented its use in Kelantan and Negri Sembilan. The implement was very simple to use provided that the tines were set at the correct angle in relation to the ground: if the angle was too great the tips of the tines dug into the ground, and if it was too small they rode over the straw without picking it up. The angle of the tines was set by adjusting the length of the top link of the tractor's hydraulic lift linkage and, after the correct setting had been found by trial and error, no further adjustment was required.

The buckrake was used to collect both the swathes of straw left by the combine and the piles left by hand threshers. The straw dropped by the combine lay on top of the stubble several inches above the ground and could be picked up very easily and quickly. Sample weighings indicated that the weight of straw in the swathe was, very approximately, 2 lb. per ft., and observations showed that the buckrake travelled forward 150 to 200 ft. per load: the weight of straw in each load was therefore 300 to 400 lb. The piles of straw left by hand-threshers were more compact than the swathes but it was more difficult to collect a full load: when the swathes were being picked up the tines lifted the entire "ribbon" of straw which rolled itself up neatly at the back of the buckrake, but the piles were collected intact and they did not slide freely on the tines. It was estimated that the average load was less than 200 lb. when piles of straw were being collected.

The hydraulic lift of the Ferguson tractor was capable of lifting full loads of straw but it was found necessary to fit front-wheel weights to improve stability and steering. High travelling speeds could be employed provided that due care was exercised when crossing a *batas* (a small earth bund); very little straw was lost when travelling although the load shook violently, even at low speeds.

PLATE I.

The Opperman Baler in use in north Kedah, December, 1953.

PLATE II.

Straw bales produced by the Opperman Baler.

PLATE III.

The Nicholson Baling Press.

The straw was unloaded by lowering the buckrake on to the ground and driving the tractor forward so that the tines slid out from beneath the load. This method left much to be desired, and it was not possible to build up high piles of straw because the tines would not slide out freely unless they were more or less level.

The time required for loading and unloading the buckrake was roughly constant, totalling about 2½ min. per load. The time spent in travelling varied greatly, depending on the length of the haul and the number of *batas* and ditches which had to be crossed. On one occasion, swathes of straw from the combine were collected and carried 120 yards: travelling time was approximately 4 min. and the total time 6½ min. per load. The buckrake therefore averaged slightly more than nine loads, or about 3,500 lb. of straw, per hour. The estimated cost of this operation is given in Table I.

Table I.

Mechanical Harvesting Trials, 1953 - 54.

Tractor-Mounted Buckrake—Estimated Costs.

(Length of haul = 120 yd.)

Item	Labour	Fuel	Depreciation, Maintenance and Repair of Buckrake	Depreciation, Maintenance and Repair of Tractor	Total
Estimated Cost per Hour	$ 0.67	$ 1.32	$ 0.10	$ 1.63	$ 3.72
Estimated Cost per Ton of Straw	0.43	0.84	0.06	1.02	2.35

BALING.

The Opperman Light-weight Baler and the Nicholson Baling Press, Type BP. 1, were both satisfactory and were capable of baling padi straw without any modification or departure from normal baling techniques. The performance of the two machines was similar, but the Opperman required a crew of three men and a boy, or four men, whereas only three men were needed for the Nicholson if the semi-automatic tying device was used.

The best methods of organising the work and the optimum bale size were investigated with the Opperman Baler. It was found that it was desirable to have two men feeding straw into the baling chamber, one man tying the knots and stacking the finished bales and a boy, or a fourth man, assisting with the tying, collecting the dividing boards and dropping them into the baling chamber at the appropriate intervals. The feeders fed the straw into the machine in armfuls and preferred not to use the locally-made pitch-forks which were available.

After experimenting with different types of bale it was decided that a size of about 36 x 14 x 17 in. and a weight of approximately 50 lb. was convenient. Bales of about this size were produced during work in Kedah

and in Negri Sembilan but a smaller bale, approximately 20 in. long and weighing 25 to 30 lb., was favoured in Kelantan. With practice it was possible to produce bales of uniform size which could easily be handled and stacked: each crew developed its own system of marking the baling chutes with chalk lines to gauge the bale length.

The semi-automatic tying device fitted to the Nicholson Baler reduced the labour required since one man could tie and stack the bales by himself. Some dexterity was needed by the operator, who had to synchronize his movements with those of this machine. Great care had to be taken to avoid twisting the loops of twine pulled through by the "needle" because, if they were twisted, the bales were tied together instead of being completely separate. Bales which were tied together were difficult to deal with because the straw expanded as soon as the twine was cut and they could not easily be retied. The best method of dealing with such bales was to tie them separately with new twine and then cut the two apart.

In timed trials in Kedah it was found that the average output of the Opperman Baler was 1,300 lb. per hr. or 325 lb. per man-hr. Rather higher outputs were recorded in Kelantan with the same machine producing smaller bales, but the figures in this case were based on average bale weights and were not so accurate as those obtained in the Kedah trials. In Negri Sembilan, the Nicholson Baling Press gave outputs of 1,200 lb. per hr. but, again, this figure was derived from the number and average weight of bales and not, as in the Kedah trials, upon direct weighings. Details of the outputs and working rates are given in Table II, and the estimated cost of baling is given in Table III.

It will be seen from Table III that the cost of twine is a major component of the total cost and is, in fact, greater than the cost of labour. It follows, therefore, that techniques which save twine are at least as important as those which increase output and thus reduce the labour cost. The twine used for baling is made from sisal and is fairly thick, averaging about 225 ft. per lb. The cost of imported twine in the Federation of Malaya during 1954 was approximately 63 cents per lb. The amount of twine required to bale one ton of straw may be roughly calculated from the size and weight of the bales: small bales require more twine per ton than larger ones of the same density, the approximate amounts being:-

Size and Weight of Bale.		Twine per ton.
Kedah Type	36 x 14 x 17 in. weighing 50 lb.	810 ft. or 3.5 lb.
Kelantan Type	20 x 14 x 18 in. weighing 27.5 lb.	1,080 ft. or 4.75 lb.

The weight of twine used in the timed trials in Kedah was recorded: the actual amount used was just under 4 lb. per ton, or about 14 per cent more than the theoretical requirement, the wastage being accounted for by careless knotting and cutting. Figures for twine consumption were not recorded in Negri Sembilan or Kelantan but it is probable that about 5 lb. per ton was used to produce the smaller bales favoured in the latter State. Other conditions being equal, therefore, these small bales cost 63 cents a ton, or about 8 per cent, more than the larger ones.

Table II.

Mechanical Harvesting Trials, 1953 - 54.

Balers—Outputs and Working Rates.

Site	Machine	Crew	Average Size of Bale	Average Weight of Bale	Output per Hour		Output per Man-Hour		Working Rate	
					No. of Bales	Weight of Bales	No. of Bales	Weight of Bales	Hours per Ton	Man-Hours per Ton
		men	in.	lb.		lb.		lb.		
Kedah: Timed Trials	Opperman: engine-driven	4	36x14x17	50	26	1300	6.5	325	1.7	6.8
Kelantan: Average of Routine Work	Opperman: engine-driven	4	20x14x18	27.5	57	1568	14.25	392	1.4	5.6
Negri Sembilan: Average of Routine Work	Nicholson: tractor-driven	3	30x14x16	40	30	1200	10	400	1.9	5.7

Table III.

Mechanical Harvesting Trials, 1953 - 54.

Balers—Average Cost of Baling.

Machine	Item	Labour	Fuel	Twine*	Depreciation, Maintenance and Repair of Baler	Depreciation, Maintenance and Repair of Tractor	Total
Opperman: engine-driven	Average Cost per Hour	$ 1.49	$ 0.60	$ 1.60	$ 1.46	$ Nil	$ 5.15
	Average Cost per Ton of Straw	2.34	0.94	2.52	2.18	Nil	7.98
Nicholson: tractor-driven	Average Cost per Hour	1.19	1.32	1.35	0.72	1.63	6.21
	Average Cost per Ton of Straw	2.22	2.70	2.52	1.34	3.04	11.82

* Twine costs are based on figures recorded in Kedah, i.e. 4 lb. per ton.

Collection of Straw Bales.

A Ferguson tractor and trailer were normally used to collect the finished bales from the field during the trials in Kedah. Approximately 75 bales, or about 3,750 lb. of straw, could be safely carried. The bales were removed from the trailer at the roadside and were subsequently collected by a five-ton, long wheel-base lorry, which could safely carry 120 bales, or about 7,000 lb. of straw. No records were kept for these operations but it is estimated that handling would cost about $1 per ton, or 2 cents per bale, and that transport in tractor trailers and lorries would cost about 20 cents and 30 cents per ton mile respectively.

Cost of Baled Straw.

An estimate of the total cost of baled straw delivered to an Agricultural Station can be estimated from the figures obtained during the trials. Neglecting the value of the straw itself and assuming that the straw is carried 10 miles by road, the cost of collecting, baling and transporting one ton will be:-

	$
Collection of straw [Table I]	2.35
Baling with Opperman Baler [Table III]	7.98
Collection of bales, including loading, transporting half a mile with tractor and trailer and transferring to lorry	1.10
Haulage in five-ton lorry for 10 miles	3.00
Total	14.43

If the Nicholson Baling Press is used the costs will be slightly higher, i.e. $18.27 per ton.

Discussion.

The tractor-mounted buckrake is a convenient implement for collecting straw, and the cost of operation is not high. It can be used to the greatest advantage in conjunction with an engine-driven baler since one tractor can then be used to tow the baler into position, to collect the straw and to carry away the bales. The locally-made buckrake used during the trials was not entirely satisfactory because of the difficulty of unloading and because the wooden tines had deteriorated. A small quantity of *tempenis* timber has now been obtained and a new buckrake with wooden tines and a metal frame is under construction. This implement will be fitted with a catch to allow the tines to be tilted downwards during unloading.

Both the balers used during the trials were satisfactory and were reliable, although the ignition system and governor of the engine of the Opperman Baler gave trouble at first. No direct comparison between the outputs of the engine- and power-take-off-driven machines was possible because they were never used at the same site or by the same crew, but the cost of baling per ton was considerably less where the engine-driven machine was used.

The final choice between the two types of drive will depend on circumstances. For example, in Kedah, where the fields are large and the soil is usually dry at harvest time, it will be convenient to use an engine-driven baler since the tractor needed to tow the machine from field to field can be used to collect the straw with a buckrake. In Negri Sembilan, however, where small fields and wet ground will make the use of a tractor-mounted buckrake impossible, it may still prove economic to collect the straw by hand and carry it to a tractor-driven baler standing on firm ground.

During the trials in Kedah, the baler was set up in a central position and the straw was brought in from a considerable area by the buckrake. This system is undoubtedly the best where a combine has been used and the straw is left in uniform swathes over the whole area, but where the crop has been threshed by hand or by mechanical threshers, or where the fields are small and there are many *batas*, it may be desirable to move the baler to the individual piles rather than to carry the straw over long distances to the baler. Neither of the balers could be conveniently used in this way, but if the Opperman Baler was modified so that the drawbar could be placed at the front, i.e. at the drive end, it would be possible to work the baler while it was attached to the tractor drawbar and no time would be wasted in setting-up. Such an arrangement would be of particular value where small amounts of straw are to be baled on a number of different holdings or for general contract work.

The trials of the balers were somewhat unique in that the machines required little or no modification for Malayan conditions and were immediately successful. The State Agricultural Officer, Kelantan, for example, wrote of the trials:-

(a) "Kelantan is so stock minded and manure conscious that anything which will assist in the production of cattle manure without involving too great a radical change will undoubtedly receive a trial. The baler, in my view, is just what is wanted to ease handling and storage of padi straw later to be used for bedding cattle. It remains for us to demonstrate the system and this we are now doing at most of our Stations."

(b) "The machine performed very successfully. It is a pity we did not have a few more of them or some other form of baler. I could use them all here."

It is hoped that 5,000 bales, or about 65 tons, of straw will be produced in Kelantan during the 1954-55 harvest, as compared with 886 bales during the last season's trials.

Summary.

Trials with a tractor-mounted buckrake and balers were undertaken to assess the suitability of standard equipment for Malayan conditions, to determine the cost of baling and to provide Agricultural Stations with baled straw.

An old hay-sweep was converted into a tractor-mounted buckrake, and an engine-driven baler was purchased. A second baler, modified for tractor power-take-off drive, was purchased by the State Agricultural Officer, Negri Sembilan.

The buckrake was capable of collecting straw at a cost of about $2.35 per ton (Table I) but was not entirely satisfactory.

The Opperman Light-weight Baler required a crew of four and produced about 1,375 lb. of bales per hr. (Table II) at a cost of about $7.98 per ton (Table III).

The Nicholson Baling Press, Type PB1, required a crew of three and produced about 1,200 lb. of bales per hr. (Table II) at a cost of about $11.82 per ton (Table III).

The cost of twine is approximately equal to the cost of labour, and economical techniques are thus desirable. Small bales weighing about 30 lb. use more twine than larger ones weighing about 50 lb. and cost 63 cents per ton, or about 8 per cent, more.

The total cost of collecting and baling straw, carting bales to the roadside and transporting them 10 miles by lorry is estimated at $14.43 per ton, including handling.

Acknowledgements.

I am deeply indebted to the State Agricultural Officer, Kelantan, for information on the trials of the Opperman Baler in Kelantan, and to the State Agricultural Officer, Negri Sembilan, for details of the trials of the Nicholson Baling Press in Negri Sembilan. I am also very grateful to the State Agricultural Officer, Kedah, for his help during the early trials of the Opperman Baler in Kedah.

References.

(1) Anon (1939): "Padi Planting Methods in Malaya."—*Malay. agric. J.* **27**, 40.

(2) Cook, J. (1948): "Fallow Season Cultivation of Irrigated Padi Land in Malacca."—*Malay. agric. J.* **31**, 115.

NOTES ON CURRENT INVESTIGATIONS, RESEARCH OCTOBER TO DECEMBER, 1954

Compiled by the Chief Research Officer

Padi.

Selection.

Transplanting of all field experiments was completed during the quarter and harvesting of short term varieties had commenced in Pahang and Kedah.

Introduced Varieties.

Philippine and other varieties under observation in the Kuala Lumpur padi cage—as is usually the way with introduced varieties—show little promise apart from the possession of short maturation periods.

Hybridisation.

The more advanced of the Cuttack hybrids are now in F_4 and the vigour of the better segregants is showing marked improvement over previous generations. The earliest flowering segregants are still remarkably poor in vigour and it is doubtful if any of these will be worth selecting. The more vigorous material, however, covers a maturation period range from 100 to 160 days, which should meet all local requirements for short term varieties.

Photosensitivity.

The light control installation in the Kuala Lumpur padi cage appears to be working satisfactorily. Siam 29, subjected to short day (11½ hours) conditions from sowing, commenced flowering some 70 days after sowing.

Nutrient Requirements and Uptake during Growth.

Pot culture investigations referred to in the last report are continuing satisfactorily but are still incomplete.

Field sampling of plants for chemical analyses also continues.

Pest Control.

The randomised pot experiments, sprayed with Endrin and Dieldrin at ½ lb. active ingredients per acre, gave inconclusive results in stem-borer control. Endrin has proved lethal to fish.

Disease Control.

In the first series of pot experiments designed to discover the most effective method of seed treatment, three organic mercurial seed dressings (two dusts and one liquid) and one dressing based on tetra-methylthiuram-disulphide (TMTD) were tested. All mercurials gave improved germination; TMTD was rather less effective.

Work is proceeding on the isolation, identification and pathogenicity testing of the fungus flora of padi seeds.

Blast *(Piricularia oryzae)* caused serious damage to nurseries of the susceptible variety Nachin 11 in Malacca. These nurseries were sown during the padi growing season, the heavy attack being due to the presence of infection on the more mature padi.

Cacao.

Selection and Breeding.

A total of 1,100 pods has been analysed for bean content from experimental fields at the Federal Experiment Station, Serdang.

An exploratory breeding programme has been commenced using as parents preliminary selections from as many progenies and in as many suitable combinations as possible. Thirty-one flowers have set amongst parental combinations which include self compatible Trinitario, self incompatible Trinitario, Amelonado, Upper Amazon and Criollo (local).

Seventy-eight seedlings of Upper Amazon (Nanay 32) x Amelonado with 22 Amelonado as control have been planted out in Field 45A, Federal Experiment Station, Serdang.

Fermentation.

Gradual improvements have been made in micro-fermentation technique. Tests are in progress with temperature control as recently suggested by workers at Messrs. Cadbury's laboratories.

Oil Palm.

Breeding Programme.

Individual palms of the dumpy "backcross" experiment on an estate in Selangor have been labelled in anticipation of commencement of harvesting in April.

"Bronzing" of Fronds.

All the data from chemical analyses of frond samples has been examined in respect of correlations of potash and magnesium deficiencies with "orange spotting" and "yellowing" of fronds. A report has been prepared for publication.

Coconut.

Breeding.

Harvesting of nuts from selected trees at Port Swettenham continues. A total of 567 nuts has been harvested and 194 germinated.

Pest Control.

Tests with grubs of *Oryctes* in boxes holding approximately 20 lb. of sawdust showed that a kill of 70 per cent was given in nine days with Aldrex 2 at 1/20 and Dieldrex 15 at 1/15, and 60 per cent kill with Dieldrex 15 at 1/20 and BHC (6.5 per cent gamma) at 6 gms. per litre. The mortality among controls was 15 per cent. The volume of fluid used was 750 c.c., two lots of 10 grubs being used per treatment. Previous tests with only

250 c.c. fluid gave inconsistent results due to inadequate penetration of the medium.

A second visit to an estate in Province Wellesley showed that, in December, parasitism of pupal *Artona catoxantha* Hamps. by the Tachinid fly *Ptychomyia remota* Ald. reached 51 per cent in the most heavily attacked areas. There was also *Artona* damage in an adjacent estate downwind from the original outbreak area; here the pupal parasitism by *Ptychomyia*, from examination of 669 puparia, reached 45.7 per cent.

Damage by the chafer *Apogonia cribricollis* Burm. to leaves of young coconut palms is a new record for this beetle, common enough on oil palm.

Tea.

Disease Control.

Blister Blight.

A test of four fungicides has been completed at the Federal Experiment Station, Cameron Highlands. Spraying was done at intervals of two weeks: at such long intervals, none of the fungicides tested gave adequate control during the rather severe blister blight infection which developed towards the end of the experiment.

Pineapple.

Canning Research Station.

The examination of the second field trial on canning stale fruit has started.

Fruit examination and canning has continued on trials previously reported.

Chemical Analyses.

Chemical analyses of fruits from the experiment SEL. 98 (Potash) at Jalan Kebun, Selangor, have continued, although on a reduced scale due to absence of ripe fruit. The opportunity was then taken to start leaf analyses from the same experiment. Results on fresh fruit have confirmed those reported in the previous quarter.

Disease Control.

Cultures of bacteria have been made from fruits affected by fruit rot with a view to carrying out tests to discover if any of the bacteria are primarily responsible for causing the disease.

Pasture and Fodder.

Green Fodder.

Monthly analyses of Trial F.E.S.S. 126 (Manurial on Pasture with Shade) have continued. Investigations into methods of sampling and analysis have continued. The results are with the Statistician for analysis.

Vegetables and Food Crops.

GROUNDNUT.

Selection plots have been reaped; the crop was, unfortunately, seriously damaged by rats but useful yield data was nevertheless obtained. A careful review of yield and selection records from the inception of this project has been made and the 214 selections have been reduced in number to 125 which have been replanted. It is hoped that if the current crop grows satisfactorily a sufficient further reduction in the number of selections can be made and a final replicated selection trial carried out.

SWEET POTATO.

The varietal collection at Serdang was replanted during the quarter. The layout has been redesigned in harmony with a preliminary botanical classification of the varieties. The Agronomy Branch has been asked to resume records of yields of 'tops' on the current crop.

SOYA BEAN.

No recent field observational data are available on which further selection could be based. Selection has, however, been carried out after scrutiny of all yield data available since 1948 and approximately half the selections have been discarded. Both series of selections (Cosmopolitan and Indonesian) have been consolidated and 38 lines retained. Some of these appear to exhibit photosensitivity. It is proposed, therefore, to resume selection in two groups to be planted in two series of spring and autumn planted experiments, each group being maintained in multiplication plots in its 'out of season' phase.

PEST CONTROL.

Randomised insecticidal tests have been set up at Tanah Rata, Cameron Highlands, against cutworms (*Agrotis* spp.) and diamond back moth (*Plutella maculipennis* Curt.).

Fibres.

MANILA HEMP.

Further reports from the United Kingdom on samples submitted confirmed the general superiority of the variety Tangongon in all respects.

Enquiry was made in the Philippines and information was obtained confirming that there is no variety with proved immunity or resistance to Bunchy Top disease.

Collection of the weevils *Odoiporus longicollis* (Oliv.) and *Cosmopolites sordidus* (Germ.) from the Federal Experiment Station, Serdang, confirms that the former is practically confined to the upper portion of the stem while the latter breeds only at or below ground level and prefers banana plants.

Spices.

CLOVES.

Several clove plantations in Penang were visited to discover how widespread and serious are the two diseases, sudden death *(Valsa eugeniae)* and dieback *(Cryptosporella eugeniae)*. Both diseases were found to be of common

occurrence, all plantations inspected being infected by one or other or both fungi. *Valsa eugeniae* appeared to be causing the more serious damage, many trees having been completely killed by this fungus. This disease will continue to be serious while the common practice continues of planting seedlings near moribund trees to replace these when they eventually die. *Cryptosporella eugeniae* was seen to be causing severe die-back on many trees. The two fungi quite commonly occurred on the same tree.

Cryptosporella eugeniae was also discovered on a clove tree at the Federal Experiment Station, Serdang, causing die-back. At the same locality, probably the same species was found causing die-back of *jambu berteh* and *jambu merah* trees (*Eugenia* spp.).

There seems no doubt that both fungi have been present in Malaya for some time.

Soils Investigations.

PADI.

Soil Survey, Trans-Perak Area.

The soil survey of this area has now been completed. Full details as to the areas of deep and shallow peat and of suitable mineral soils cannot be given until the areas on the map are measured, but the map indicates that the Raja Hitam area and the south-east of the area are the more promising from the soils point of view.

Soil Survey, Kuala Langat.

Survey work continues in the Kuala Langat Forest Reserve (North). At a rough approximation the area so far covered is about 15,000 acres. From this area only a very few samples have been other than peat. The area is almost entirely deep peat with depths varying from 7 to 11 ft. and sometimes more. To-date, 397 samples have been received from this area.

The outstanding feature so far noted in these peats is the high loss on ignition, i.e. over 90 per cent. They are also extremely acid, the average pH of the samples being little over 3.0. They thus differ quite considerably from the peats found in the Trans-Perak area which are less acid and have more ash content.

Soil Survey, Tanjong Karang.

Soil samples were taken from plots in Sawah Sampadan, Sekinchang, Sungei Burong and Panchang Bedena where the yield had been measured by crop cutting tests. The plots covered a wide range of yields. Duplicate samples were taken from each plot so that errors in sampling could be estimated. A few preliminary analyses indicated that the better areas were high in exchangeable bases.

Experiment with Various Soils in Tanks.

As noted in the previous quarterly report, a series of concrete tanks have been filled with soil from different areas. Padi seedlings were transplanted into these tanks on the 5th November. The padi in the soil from

The new Plant Pathology Laboratory of the Department, mentioned in *Malay. agric. J.* **37**, 252.

The new headquarters for the Agronomy Branch, Department of Agriculture, mentioned in *Malay. agric. J.* **37**, 251.

Tanjong Karang has grown best, but just recently the plants have shown "yellowing", which, it is suspected, may be phosphorus deficiency. Injections of various nutrients are being tried out to see if this is so.

In the Tanjong Minyak "gelam" soils, the plants are moribund and have made scarcely any growth since transplanting. They are pale and appear to be suffering from a number of deficiencies, especially calcium. Strangely, the plants in the tanks which contain only the more sulphurous sub-soil are slightly better in growth and it has been noted that there is much less H_2S emerging from the soil. Thus it would appear that the form in which the sulphur occurs as well as its quantity are important.

Miscellaneous Soil and Plant Samples.

Work has been continued on the cation exchange capacity of soils. The C.E.C. of several "gelam" soils has been estimated by leaching both with ammonium acetate and with calcium acetate. Another method using cation exchange resins is to be tried.

The exchangeable magnesium of several padi soils has been investigated and results in many instances have shown surprisingly high figures. Difficulties with the analytical method have been met, but it is hoped that the new Spekker Absorptiometer will solve these problems.

Padi leaf samples have been taken from two 3³ factorial manurial experiments at Hutan Kampong and Salak Kanan in Kedah. The samples were taken at approximately eight weeks after transplanting, and were brought back to the laboratories in Kuala Lumpur in polythene bags. Results of analyses indicate that phosphate manuring has considerably increased the uptake of phosphorus.

Other Crops.

Soil Survey, Trengganu.

Field work on the Trengganu soil survey was continued during the first six weeks of the quarter, reconnaissance trips being made into two areas believed to contain soils suitable for cacao. In the first of these areas, to the west of the Kota Bharu to Kuala Trengganu road between the 23rd and 37th milestones, a provisional estimate of 15,000 acres of suitable soil, derived from granitic rocks over moderately undulating country was identified, while in the second area, along the Ajil to Jerangau road, the area of potential cacao land is provisionally estimated at 20,000 acres. Field work for the 1954 season was concluded just prior to the start of the monsoon and the remainder of the quarter was spent in the preparation of maps and reports covering the year's work.

Soil and Leaf Sample Analyses (Oil Palm).

Samples of oil palm frond were taken from an estate in the coastal area of Selangor where considerable "yellowing" of young palms was present. The palms were found to be very low in magnesium.

Soil samples were also taken but the chemical analyses have not been completed.

NOTES ON CURRENT INVESTIGATIONS, AGRONOMY OCTOBER TO DECEMBER, 1954

Compiled by the Senior Agronomist

Padi.

In the Kedah-Perlis-Province Wellesley region agronomic trials are proceeding according to plan and some interesting results are expected. Observations on growth in factorial trials suggest that small nitrogen dressings are beneficial in those areas where bat guano is applied at regular intervals. There is also some suggestion that moderate dressings of potash are beneficial but this will need confirmation after harvest.

There would seem to be no justification for the commercial use of soluble superphosphates in this region since a somewhat larger application of insoluble fertilisers gives comparable results at a lower cost.

Yields will be low in certain areas because of delayed transplanting and premature drying-out of the land at flowering time. *Penyakit merah* has also been widespread in north Krian and scattered localities in south Kedah.

In the north-east coast region the experimental programme is proceeding satisfactorily.

The widespread distribution of six-plot factorial trials on smallholders' land is expected to provide very valuable response curves for phosphate in the presence and absence of nitrogen. In some States siting has been on a random basis, which is desirable, but this makes supervision difficult.

The two States of Negri Sembilan and Trengganu were very well covered last season with simple manurial trials on smallholders' land. In the former State there were 50 trials and the response in yield to 60 lb. nitrogen and 40 lb. P_2O_5 per acre, in the presence of 30 lb. per acre of potash, averaged 140 gantangs per acre. The P_2O_5 was supplied as double superphosphate but different types of phosphate are also being tested.

In one series of 49 trials in Trengganu, the response to 100, 200 and 300 lb. per acre of standard padi fertiliser was linear with the increase averaging 151 gantangs per acre for the 300 lb. dressing.

Good responses continue to be obtained in Kelantan where an application of 204 lb. per acre of padi fertiliser led to increases in yield varying from 47 to 207 gantangs per acre.

Herbicide tests on a broadcast padi crop at Teluk Chengai, Kedah, have shown that good weed-control can be achieved with several different formulations and that dosages of 1, 2 and 3 lb. per acre acid equivalent are all equally effective. This suggests that smaller dosages than 1 lb. per acre would be worth testing.

Cacao.

At the Federal Experiment Station, Jerangau, in Trengganu, basket nurseries have been sown for an important new manurial experiment with

West African Amelonado cacao which is due to be planted in 1955.A lime-phosphate, simple factorial experiment was planted in September and subsequent growth has been satisfactory.

A trial to compare hard and soft treatment of seedling nurseries commenced in October. Germination and subsequent growth in the soft nursery has been good, but the hard treatment has been too severe and some modification has been necessary whereby early temporary shade is provided.

A second durability trial with two types of paper pots has confirmed that they disintegrate too soon to be of value for raising cacao seedlings.

Good progress has been made with a topographical survey of the Jerangau Station, but field work has been interrupted by the north-east monsoon.

An attempt to intercultivate cacao and hedge-row rubber on degraded lateritic soil at Gajah Mati in north Kedah has now been abandoned because it has been impossible to provide satisfactory growing conditions. It should be noted, however, that a somewhat similar trial on an estate in Malacca is showing promise.

Mammalian pests of cacao are of great importance when small areas come into bearing. Musang are the worst pests at Serdang, Selangor, but rodents are the chief offenders in Kedah and Trengganu. The common tree shrew, *Tupaia glis*, and the red-bellied squirrel, *Callosciurus notatus*, are commonly observed at Jerangau, where shooting has proved to be the most reliable method of control. Trapping at Gajah Mati, Kedah, has accounted for more tree shrews than squirrels.

A variety trial has been abandoned at Ayer Itam Agricultural Station, Penang, because the soil type has been shown to be unsuitable.

It has been noted in Perak that cacao grows well beneath the shade of established durian orchards.

Very vigorous cacao growth has been recorded on volcanic soil in Pahang and Negri Sembilan.

A transplanting experiment with bare root seedlings was planted out at the Federal Experiment Station, Serdang, in November under favourable conditions but the general health of the plants is now unsatisfactory.

Coconut.

It has been noted on a Selangor estate situated on coastal organic clay that disc-harrowing of covers favours the growth of the creeping cover *Mikania scandens* at the expense of grasses. This is not an ideal cover but it seems to be beneficial when kept under control. This cultivation treatment has been tested against hand slashing over a five-year period and has been proved to be not harmful.

Oil Palm.

A factorial manurial trial has been laid down on an estate in south Perak in co-operation with the Department. The treatment combinations include three levels each of phosphate and nitrogen and two levels each of potash and magnesium.

Fibres.

Manila hemp has been an unexpected failure at Sungei Burong, on the Selangor coast. The soil appears to be suitable but it is possible that the site is too exposed to wind damage.

At Sungei Ruan, Pahang, Tangongon is yielding best in a variety trial, and this agrees with experimental results elsewhere.

Tea.

Mean yields from a nitrogen manurial experiment at the Federal Experiment Station, Cameron Highlands, for the first half of the third year of its pruning cycle are given below:-

	Nitrogen Application per Acre per Annum			
	0	40 lb.	80 lb.	120 lb.
Yield of green leaf (lb. per acre)	1,809	1,999	2,051	2,250
Yield of made tea (lb. per acre)	398	440	451	495

Increments due to manuring are relatively low, perhaps because of the generally high level of yields.

Pineapple.

The first harvest from a 'type of phosphate' experiment at the Federal Experiment Station, Jalan Kebun, has shown no noticeable difference in either yield or fruit size.

Early results from other manurial experiments at this Station suggest that pineapples on freshly opened peat land after a light burn do not benefit from fertiliser in their first year, except possibly when they are planted very closely.

In a ridging and spacing trial there is much earlier fruiting on ridged plots than on flat ground, but there is little variation in fruit size with different spacings. A single row ridged is associated with considerable broken fruit stem but there is more erect growth when the ridges accommodate two rows.

No attack by fruit rot has been noted at Jalan Kebun, although it is serious in Johore plantations.

Orders have been placed for special equipment for the commencement of mechanisation investigations. Other machinery is being fabricated locally.

A factorial manurial trial with the variety Mauritius was laid down on coastal sandy soil in Kelantan during November.

Vegetables and Food Crops.

Seven different varieties of cabbage raised from seed are now being tested at the Federal Experiment Station, Cameron Highlands, against the Japanese Succession type raised from axillary cuttings, because clones of this variety have shown considerable deterioration in recent years.

Growth has been good in a variety trial of Pigeon Pea, *Cajanus indicus*, at the Federal Experiment Station, Gajah Mati. Five Jamaican strains and one Bahamas variety are being tested against the local Kedah crop and some of the earlier ones are now coming into bearing. A crop of the variety Bahamas Late, planted in 1953, has shown no promise at all. Vegetative growth has been vigorous but cropping has been negligible. All eight varieties are also being cultivated in observation plots at the Federal Experiment Station, Kuala Lumpur.

A variety trial with lowland cauliflowers has been laid down in Kuala Lumpur.

Comparative trials with various seed composts have shown that best results are obtained with a modified John Innes compost using steam-sterilized loam. The Chinese vegetable-growers' burnt-soil technique increases available bases in the soil but reduces the content of nitrogen.

Fruits.

Growth of bananas in a manurial trial at the Ayer Hitam Agricultural Station, Johore, has been disappointing and the nitrogen levels have been doubled.

Seed of *Annona cherimolia* has been imported from Poona, India, and germination has been satisfactory. This should be a valuable fruit tree for the highlands.

Investigations at Serdang on the propagation of rambutans by rooted cuttings have shown that better results can be obtained in the cacao spray-propagator than in normal frames. Semi-hardwood cuttings root more readily than hardwood ones and the hormone Seradix B improves take, especially with the more difficult hardwood material. Clones differ in their rooting ability, and the vigorous clone R.84 is the most easily rooted of those tested so far.

Many rogues have been detected in a large rambutan variety trial at Serdang. In at least one case bud-sporting has been responsible as a yellow-fruited tree has been found to be identical in all other respects with the very distinct red-fruited clone R.99.

Green Manures.

Trials to test the effect of growing the green-manure crop *Sesbania speciosa* have been designed for off-season padi areas. Two of these have already been laid down in north Kedah and growth has been very satisfactory. The green-manure seed is soaked in water and then broadcast into the standing crop of padi about one week before harvest.

Goats.

Twenty kids have been born at Serdang and there has been one death. A total of 27 animals have been either sold to breeders or distributed to Field Branch Officers for Extension stud purposes.

Bali Cattle.

Two male calves were born at Serdang and the herd is in good health.

Pigs.

A pig-feeding trial designed to test the value of feeding a supplement containing Vitamin B.12 and aureomycin to weaner pigs has been concluded after treating twelve litter-replications of six weaners each at the Federal Experiment Station, Serdang. Feeding the supplement from weaning until the pigs reached one picul live-weight has been proved to increase the daily live-weight increase by a small amount, but it is not yet possible to assess the economics of this practice since food consumption figures have still to be studied in detail.

One Large Black boar at Serdang had to be destroyed because of persistent lameness. Another imported experimental boar, a Wessex Saddleback, died from drowning in Perak.

NOTES ON EXTENSION WORK OCTOBER TO DECEMBER, 1954

Compiled by the Acting Chief Field Officer

Padi.

Yields of the order of 290 to 330 gantangs of Taiwan padi per acre were obtained from the 9,300 acres of off-season crop planted in Province Wellesley.

Although unseasonable weather, drought in some cases and floods in others, occurred early in the quarter and delayed, in varying degree, both cultivation and transplanting in most States, no diminution in the total area to be planted in the main 1954-55 season was expected; on the contrary, some States and Settlements, Malacca, Pahang and Johore especially, anticipated increases in acreage. One expected result from the unforeseen delays was the increased tendency to use over-age seedlings, a practice known from past investigations to have a markedly reducing effect on yields. Consequently, in all States, there was intensified propaganda in the field to discourage this practice and persuade planters to resow nurseries with selected short-term padis of which there was seed available.

For the current season the estimated acreage actually planted from an expected total of 888,990 was reported as 864,290 at the end of December.

On the assumption that the simple Field Demonstration Plot may be considered as the Department's shop window for the display of those of its wares having particular significance to the rural population, Field Demonstration Plots, as detailed in Table I, have been arranged to draw attention to seed and manurial treatments, all of which are recommended following on the results of research.

Table I.

Field Demonstration Plots.

State	Varietal Plots	Manured Plots
Kedah	63 (Subang Intan)	127
Kelantan		363
Trengganu	6	175 (wet padi)
	9	21 (dry padi)
Perak	538 (Machang, Mayang Sa Batil Seraup, Seri Raja)	563
Pahang	100 (Serendah Kuning)	200
N.Sembilan	150 (Serendah Kuning)	157
Johore		23
Total	866	1,629

In Kedah, where the harvest of short-term strains had commenced at the end of November, a Burma hybrid, A28/8, introduced by the Department

in 1948 was reported to be yielding at the rate of 640 gantangs per acre and had attracted considerable attention from local farmers. The recent success, in Kelantan, of a demonstration covering 80 acres, showing how it was possible to take a crop of Taiwan padi from areas subjected annually to brackish water inundation late in the season, has stirred local interest to such an extent that the technique will undoubtedly be fully exploited next season.

Reduction in the subsidy for fertilisers from $6 per 100 lb. last season to $4 per 100 lb. this season, withdrawal of the transport subsidy and a general lack of ready cash are all given as reasons for the reduced use of fertilisers by padi farmers in Kelantan. Up till the end of December only 349.2 tons had been bought as against 719.3 tons in 1953, a season of extreme adverse weather conditions. No fertiliser subsidy is granted to West Coast farmers; they must buy at commercial rates. Significant progress in the increased use of fertilisers would, therefore, appear to be taking place in Kedah where 386 tons had been purchased up to the end of October, 1954. compared with a total of 411 tons for the whole of the 1953 season.

Seed padi distributed from Departmental sources totalled 2,214 gantangs (12,398 lb.).

Judging in the Annual *Sawah* Competition was in progress at Kahang in Johore.

Rubber.

The activities of the Department were mostly concerned with the procurement of selected rubber seed, establishment of clonal seedling nurseries, maintenance of budwood nurseries and the distribution of improved planting material, both budwood and seedlings. All these undertakings were in fulfilment of the role played by the Department in the Smallholders' Rubber Replanting Scheme as the sole supplier of all improved planting material required. In practice, this necessitated the collection of sufficient selected seed to establish upwards of 175 acres of Departmental and Contract nurseries as well as the handing over of 38,112 yards of budwood and 1,880,822 seedlings from established nurseries to officers of the Rubber Industry (Replanting) Board. In addition, the distribution of 1,589 yards of budwood and 172,932 clonal seedlings catered for the needs of new planting. The attendant danger of soil erosion in the Jelebu District of Negri Sembilan, where new and replanting of rubber were well under way, was noted by the State Agricultural Officer who accordingly arranged for three local Malays to be trained in the technique of contour lining with a view to contract work in that particular District. Working on contract at a fixed rate of $6 per acre they have so far contour lined a total of 144 acres.

Fruit.

Improved nursery techniques and increased use of spray irrigation have enabled the Department almost to cope with the heavy demands made on it for improved fruit planting material. Most of this material found its way to Settlement Schemes for ex-Police Constables and to those who have, under the Rubber Replanting Scheme, elected to plant fruit as an alternative crop to rubber.

During the quarter, sales from Agricultural Stations totalled 20,297 basketed plants, buddings or marcots.

From Johore, Perak and Selangor came reports of fruit multiplication nurseries established in the *kampong** under the guidance and direction of officers of the Department of Agriculture. At the end of November, 1954, there were 20 such nurseries in Johore, three in Perak and one in Selangor. There was news, too, of a Field Budding Team from Degong Agricultural Station in Perak having successfully budded 200 rambutan trees on behalf of local farmers.

Cacao.

The State of Pahang is looking to the future, and the State Agricultural Officer has reported as follows:-

"There is now in Pahang a solid foundation for a future cacao industry. It is worth recounting the steps taken so far. In 1948, Trinitario cacao plots were established all through the State on Agricultural Stations. In 1951, all these areas and also a plot of pre-war cacao, growing at Temerloh, were converted to Amelonado cacao either by replanting or budding. The complete elimination of Trinitario from Agricultural Stations and the speedy production of Amelonado pods from rejuvenated cacao has made it possible for the State to be independent of Serdang supplies for the projected orderly expansion of the crop. A further seven acres of Amelonado was established on Pahang Volcanic soil in 1954 and later this year a further 45 acres of the same series has been obtained in order that immediate advantage could be taken of the suitability of the soil, under thinned jungle, for the rapid increase of the available seed supply. The new 45 acre block is already in the course of phased development. Having taken all possible steps to ensure that the future seed supply will be adequate, a suitable area of 15,000 acres of Volcanic soil, Kuantan Series, has been reserved for the development of cacao. This basic plan for development has received the unanimous assent of the Council of State and details are now being worked out by the State Natural Resources Board. Briefly, the plan calls for extraction of valuable timber from the area, according to a clearly defined plan, thus releasing 500 acres of land per annum for cacao. The first coupe will be handed over for agriculture towards the end of 1955."

Pineapple.

Upwards of half a million suckers as planting material were supplied to ex-Special Constables farming on the peat areas of Sekinchang in Selangor. In this State, the pineapple is an important smallholding crop and 40 manurial and cultural demonstration plots have been laid down by the Department of Agriculture in the important pineapple growing areas. So important is this work considered that the services of one member of the junior staff of the State Department of Agriculture have been made over to it, full time.

---

* Villages.

Shade and Ornamental Trees.

As a sideline the Department undertakes propagation of shade and ornamental trees. During the quarter, some 5,450 basketed plants were issued free to various Government Departments or sold to the public.

Grazing Reserves.

The potentialities of *Stylosanthes gracilis* under East Coast conditions as a cut fodder for stock have been amply demonstrated at Kota Bharu Agricultural Station, Kelantan. Work was, therefore, begun in November to have it established in two cattle grazing reserves in Kelantan, i.e. Labu and Bukit China.

Mechanisation.

Departmental tractors working on hire in Selangor earned $4,850. They were employed mainly on replanted rubber holdings.

Livestock.

Pigs.

There has been no slackening in the demand for pure-bred stock and 82 Middle White weaner boars plus 111 weaner gilts were sold from Departmental breeding centres, ultimately to be used for crossing with the local Chinese Black. Implementation of the Department's declared policy to maintain pure-bred Middle White boars at stud in all pig-rearing centres of importance, including new villages, was continued, especially in Johore. That this policy is welcomed is shown by the fact that 250 Chinese Black sows were recorded as having been served by these stud boars.

Poultry.

The Department's current policy aims at no more than meeting public demand for pure-bred stock. The following were, therefore, sold to meet the demands made:-

Cockerels	51
Pullets	119
Chicks	1,185
Hatching eggs	1,188

New Villages.

In addition to the usual routine advisory work, practical assistance rendered by the Department to new villages comprised the provision of funds for fencing, free issue of 4,000 germinated coconuts and 1,200 basketed coffee seedlings, establishment of 20,440 rubber seedlings in nurseries for new planting, ploughing 70 acres of agricultural land and clearing a further 55, all by tractor.

Agricultural Education.

Departmental activities in the furtherence of general agricultural education amongst the rural population were wide in scope and extremely varied in form, ranging from simple lectures to weekly or even two-monthly courses

in general agriculture, and from Field Days at Agricultural Stations to publication of Newsletters. In Kedah, Perak, Selangor, Pahang and Negri Sembilan, simple, inexpensive school buildings with hostel accommodation attached have been built on Agricultural Stations and are a means of providing a variety of courses on crop and animal husbandry, having emphasis on the practical rather than the theoretical side. Dependent on circumstances, courses may last from one to eight weeks. There were 12 such courses held during the quarter with an attendance of 124 trainees. Following the completion of an eight-week training course in Negri Sembilan, five of the trainees banded together and put their newly acquired knowledge to the test by beginning work on a 55 acre settlement scheme.

Not only have numerous Field Days been held on Agricultural Stations in all States, but lectures covering a wide range of subjects—principles of agriculture, simple plant physiology, stock and crop husbandry, budding, disease control, etc.—have been given to many audiences either as part of Civics Courses or to school boys, settlers in new villages and even to prisoners in some of the local jails.

Pest and Disease Control.

The incidence of damage by the Coconut Beetle, *Oryctes rhinoceros*, was reported to be on the increase. Campaigns to destroy potential breeding grounds of the beetle were launched in a number of States. In Johore and Penang a practical example and lead were given by the State Departments clearing out all potential breeding grounds found on State land.

Agricultural Bureaux.

Mindful that time to a farmer may be invaluable and that it is not possible for everyone requiring advice on agricultural problems conveniently to visit the nearest Agricultural Office, the Department of Agriculture in Kelantan has arranged that selected members of the staff attend all important weekly fairs between certain hours on each fair day. The farmers are thus aware that if assistance is required it can be obtained easily and readily by contacting the officer present at the fair. This arrangement enables closer contact to be made between the Department and farmers, thereby improving the human relationship between the two which, after all, is the key to successful extension.

This idea was also recently introduced into Pahang.

Review.

METHODS OF SURVEYING AND MEASURING VEGETATION

By Dorothy Brown, M.Sc. Bulletin No.42 of the Commonwealth Bureau of Pasture and Field Crops, Hurley, Berks., England. Pp. XV + 223 with Figs. 45, Tables 46, Bibliography Pp. 14. Price 35 shillings.

Although the technique of botanical analysis outlined in this book is devoted to the examination of the composition of grassland, the methods used are valid for the examination of ground vegetation in all parts of the world.

The ground flora of our forests and plantations can tell us much about the nature of the productivity of the soil below. Thus the use of the methods of estimating botanical composition and productivity of grass and scrubland can be readily adapted to surveying the important long term changes in the ground flora under trees and other crops.

Our rice fields are often used out of season for the grazing of cattle. We are told in this book exactly how to estimate the productivity of a field or area of grass by noting the increases in weight of the grazing livestock. Such an estimate of the initial productivity of an area of land is undoubtedly the first step to its improvement.

The book outlines under the following four heads the techniques of botanical analysis:- measuring the frequency of plant occurrence; the number of plants; the area covered by the vegetation; the weight of the vegetation. The author makes no attempt to recommend any single method as ideal because of "the impossibility of one worker, in the space of one lifetime, being able adequately to test all methods for all types of vegetation .....". In this outlook lies much of the value of this monograph, as it is undoubtedly impossible to apply one technique to the many and varied types of grassland.

The book concludes with sections devoted to utilisation and productivity, which do not appear of immediate relevance to Malayan problems, but which contain much useful and practical information for vegetation surveys and analysis, and should any large area of forest be opened up for grassland, or rehabilitation of existing grassland be undertaken, this book will be of inestimable value.

There is one criticism to be made of this excellent and painstaking work. A short chapter (by G. M. Jolly of East Malling) on the theory of sampling, whilst rightly emphasising the need for random sampling does not make it clear that a random sample must be chosen with a due regard for statistical laws, and that it is not a haphazard casting of a quadrat.

Miss Brown's book is admirably and fully illustrated and provided with a useful glossary and a comprehensive bibliography and index. It is worth the price for these features alone.

J.D.

Departmental Notes

Obituary.

It is with deep regret that we have to record the deaths of Mr. Bhoop Singh and Mr. M. Nunis, both G.C.S. timescale clerks, and of Enche Khalid bin Bana, Junior Agricultural Assistant.

Mr. Bhoop Singh joined Government Service in January, 1931, and served in the Department of Agriculture from that time until his sudden death on the 5th October, 1954. He was liked by all officers of the Department who came in contact with him, was a hard worker and never found it too much trouble to help the less experienced of his colleagues. Mr. Bhoop Singh was 41 years old.

Mr. Nunis joined the Department in March, 1942, although he had been in Government Service since 1936. During the last few years of his life Mr. Nunis suffered a great deal through illness but his courage and cheerful manner will long be remembered by his many friends in the Department. Mr. Nunis, who was 37 years old when he died on the 25th August, 1954, leaves a widow and eight children.

Enche Khalid joined the Department in July, 1941, and, except for one year during the Japanese occupation of Malaya, served continuously in the Soils Division of the Research Branch until his untimely death at the age of 36 on the 31st October, 1954. A popular officer with his colleagues and senior officers, Che Khalid was a quiet but competent laboratory worker who was always cooperative. Our sympathies are with his wife and four young children in their sad bereavement.

Retirements.

Mr. O. J. Voelcker, C.B.E.

Mr. O. J. Voelcker, C.B.E., M.A., A.I.C.T.A., Director of Agriculture, Federation of Malaya, proceeded on leave prior to retirement on the 22nd December, 1954.

Mr. Voelcker joined the Department of Agriculture, Nigeria, as an Agricultural Officer in 1928, following the normal two years post-graduate training at Oxford and in Trinidad as a Colonial Agricultural Scholar.

He became a Botanist on the staff of the same Department in 1930 and worked mainly on cacao and oil palm.

He was seconded to Trinidad from 1936 to 1938 for service with the Cacao Research Scheme there.

In 1944 he became the first Director of the West African Cacao Research Institute at Tafo, Gold Coast, and remained there until 1949.

He became Director of Agriculture, Federation of Malaya, early in 1950. When he came to the Federation, he had already achieved the status of one of the leading British authorities on cacao and his experience and guidance have been of the utmost value in our carrying out of the groundwork for the introduction of this new crop to Malaya.

When he took over as Director, there had been no permanent incumbent for nearly two years; there was, in consequence, lack of leadership, some confusion of effort and not very high morale. Funds there were in plenty but the senior staff was over 50 per cent. below strength and we were unable effectively to make use of the money available.

As he leaves us, things are very different from what they were nearly five years ago. The Department now has a well-planned programme of work, senior staff vacancies have mostly been filled and the only real "headache" is the present financial stringency. It is truly ironical that when we had plenty of money we had not the staff to utilise it; now that we have the staff, money is "tight" to a degree.

The Department in its organisation and programme of work is now very much on the right track; what is most of all now required is continuity and consolidation. The loss of Mr. Voelcker coupled with the prospective loss of Messrs. Curry and Jagoe within the next few months is a severe blow in this respect.

During his 26 years in the Colonial Agricultural Service, Mr. Voelcker has worthily maintained the family tradition in the service of scientific agriculture. In this connection, it may not be generally realised that his grandfather, Dr. A. Voelcker, F.R.S., went to England from Bavaria at the invitation of the then recently formed Royal Agricultural Society of England and worked with Lawes & Gilbert in the early days of artificial fertiliser investigations, and that his uncle, Dr. J.A. Voelcker, did outstanding work on the problems of light soils at Woburn Experiment Station which was complementary to the work on the heavier soils at Rothamstead.

Both Mr. and Mrs. Voelcker, who have been a most hospitable couple, will be greatly missed by all of us. They take with them our very good wishes for a long and happy retirement.

R.G.H.

Y. T. M. Tunku Ya'acob ibni al-marhum Sultan Adbul Hamid Halim Shah, C.M.G.

Tunku Ya'acob, since 1949 a supernumerary Senior Agricultural Officer seconded for duties outside the Department, retired from the Service with effect from 27th December, 1954.

Tunku Ya'acob was originally appointed by the Kedah Government in 1918 and was attached initially to the Kulim Land Office. He served as Assistant Land Officer and Land Officer in various Districts of Kedah until 1921 when he proceeded to the United Kingdom for advanced training in agriculture. He remained overseas until 1930, studying at Cambridge University and at the Imperial College of Tropical Agriculture, Trinidad. On

his return to Kedah he became Assistant Principal Agricultural Officer; later, in 1936, he became Principal Agricultural Officer and continued as such until 1949. He acted as Deputy Director of Agriculture on one occasion, in 1948-49.

In June, 1950, he became Acting Mentri Besar, Kedah, and in October of the same year, Keeper of the Rulers' Seal. With the setting up of the Member system of Government in 1951, he became Member for Agriculture and Forestry. He left this post in February, 1954, to become, once again, Keeper of the Rulers' Seal and he still holds this appointment. He was for several years a member both of Federal Legislative Council and Federal Executive Council. He was awarded the C.M.G. in 1947 for his services to agriculture and rural development in general in Kedah.

Tunku Ya'acob has throughout his service had foremost at heart the interests of the *raiat*. Pasar Ya'acob, the large permanent market for kampong produce of all kinds which was erected post-war in Alor Star appropriately reflects one facet of his efforts for their economic progress.

Within the Department, Tunku has always been extremely well liked for his pleasant disposition and ease of manner and we are very sorry to lose him. We wish him and Tunku Maimunah a long and happy retirement.

R.G.H.

Mr. A. de K. Frampton, C.M.G.

Mr. A. de K. Frampton, supernumerary Senior Agricultural Officer, retired from the Service with effect from 1st January, 1955.

Mr. Frampton has not served in Malaya since the war and is thus largely unknown to other than the pre-war element of the Department. He was a Colonial Agricultural Scholar at Oxford and in Trinidad from 1925-27, the same period as the writer. He served in Northern Nigeria from 1927-29 and in British Guiana from 1929-35. He transferred to Malaya as Agricultural Officer in 1935 and served in Perak and Malacca up to the outbreak of war. Since the war, he has been on secondment, first as Professor of Agriculture at the Imperial College of Tropical Agriculture, Trinidad, from 1946-49, and from 1949 onwards as Agricultural Adviser to the Comptroller for Development and Welfare in the Caribbean area.

Mr. Frampton was commissioned in the S.S.V.F., 3rd (Malacca) Battalion, and was a prisoner of war from 1942-45, being mentioned in despatches.

He was awarded the C.M.G. in 1952 for his services to agriculture in the West Indies.

Possessed of an equable temperament and great charm of manner, he was an extremely popular member of the Department in pre-war days, and those of us who were his colleagues wish him and Mrs. Frampton a retirement both long and pleasant. It is understood that he will settle in Barbados.

R.G.H.

Enche Jaafar bin Mampak, O.B.E.

On 12th December, 1954, Che Jaafar bin Mampak, Agricultural Assistant, Special Grade, retired after 30 years devoted and loyal service in the Department of Agriculture.

Che. Jaafar will always be remembered for his excellent work on the East Coast, where he served for a total of sixteen years, nine of which were in Kelantan and the rest in Trengganu. His ready assumption of responsibility during the difficult post-war years as well as the success with which he administered his appointment and his value as a committee-man did not pass unnoticed, and in 1954 he was awarded the O.B.E. Later in the same year, he was honoured by His Highness the Sultan of Trengganu who bestowed on him the title of Dato Kamal Wangsa.

In his younger days Che. Jaafar was a keen volunteer, being commissioned on the outbreak of hostilities in South East Asia. He is the holder of the Efficiency Medal and two clasps.

Che. Jaafar enjoyed great popularity wherever he went and was highly respected by junior and senior officers alike. It is understood that he has assumed duty in the post of Assistant State Replanting Officer, Trengganu, under the Rubber Industry (Replanting) Board, and it goes without saying that all members of the Department wish him success in his new post.

J.C.

Promotions.

Che. Mohamed Noor bin Wahab, Agricultural Assistant, to be a Pupil Agricultural Officer with effect from the 23rd August, 1954.

Che. Ahmad bin Mohamed Amin, Agricultural Assistant, to be a Pupil Agricultural Officer with effect from the 12th September, 1954.

Mr. Van Thean Kee, Agricultural Assistant, to be a Pupil Botanist with effect from the 12th September, 1954.

Appointments.

Mr. G. F. Darnell, Agricultural Officer, to be Agricultural Officer, Johore Central, with effect from the 6th December, 1954.

Mr. P. Class, Agricultural Officer, to be State Agricultural Officer, Negri Sembilan, with effect from the 19th December, 1954.

Mr. R. G. Heath, Deputy Director of Agriculture, to be Acting Director of Agriculture, Federation of Malaya, with effect from the 23rd December, 1954.

Mr. J. R. Curry, Chief Field Officer, to be Acting Deputy Director of Agriculture with effect from the 23rd December, 1954.

Mr. J. Cook, Senior Agricultural Officer, to be Acting Chief Field Officer with effect from the 6th January, 1955.

Mr. M. G. Hawson, Agricultural Officer, to be Agricultural Officer, Kedah, with effect from the 21st January, 1955.

Leave.

The following officers have returned from leave:-

Mr. J. Cook, Senior Agricultural Officer, on the 5th January, 1955.

Mr. F. B. Brown, Botanist, on the 31st January, 1955.

The following officers have proceeded on leave:-

Mr. G. S. Keeping, Agricultural Officer, on the 19th December, 1954.

Mr. O. J. Voelcker, C.B.E., Director of Agriculture, on leave prior to retirement, on the 22nd December, 1954.

Mr. J. L. Hitchcock, Agricultural Officer, on the 21st January, 1955.

MARKET PRICES

October to December, 1954.

Rubber.—The Singapore price of R.S.S. No.1 increased by a little more than 20 cents per lb. during the quarter, and the price on the last day of the year was over 41 cents more than on the 31st December, 1953.

October commenced with the price at 72⅛ cents but by the 14th it had reached 78⅛ cents. The price fluctuated between 75⅜ and 75 5/16 for the rest of the month, to give an average for October of 76.40 cents per lb.

In November the price soon topped 80 cents and was a little over 84 cents on the 12th. There was a drop in price to 79 11/16 on the 17th but apart from this it was over 80 cents per lb. for the whole of the second half of the month. The average price in November was 81.81 cents.

There was a gradual increase in the price from 81 cents per lb. on the 1st December to 90⅞ cents on the 24th. The first day after the Christmas holiday saw the price jump to 95 cents and then to 99⅜ on the 30th. The year closed with the price at 98½ cents to give an average for December of 86.15 cents.

The prices mentioned above are the noon buyers' prices for rubber f.o.b. in bales, are as reported by the Singapore Chamber of Commerce and have been taken from the Monthly Statistical Bulletin of the Federation of Malaya.

The average prices paid during the quarter for smallholders' rubber at three towns in the Federation of Malaya are given in Table I.

Table I.

Average Monthly Prices Paid by Local Dealers for Smallholders' Rubber, October to December, 1954.

(Dollars per picul of 133 1/3 lbs.)

Grades.	Taiping, Perak.			Seremban, Negri Sembilan.			Batu Pahat, Johore.		
	Oct.	Nov.	Dec	Oct.	Nov.	Dec	Oct.	Nov.	Dec.
Smoked Sheet No. 1 ..	85.64	91.16	95.32	85.16	90.77	95.34	84.70	90.00	94.90
Unsmoked Sheet ..	71.61	75.00	76.87	68.08	74.42	77.30	76.00	80.17	83.19
Scrap ..	45.68	48.81	49.03	50.22	53.08	63.05	30.15	29.75	33.90

This Table has been compiled from statistics supplied by the Registrar of Statistics, Federation of Malaya.

Tea.—There were no sales of Malayan tea in Colombo during 1954.

The average prices paid for Ceylon teas at the public sales in Colombo on the 21st December, 1954, as reported in the Weekly Tea Market Report of the Colombo Brokers' Association, were as follows, in rupees per lb.:- High Grown Teas 3.35, Medium Grown Teas 3.16 and Low Grown Teas 3.26.

The retail price of Malayan tea (Singapore Cold Storage Co., Ltd.) in Kuala Lumpur is $2.55 per lb.

In a statement published by the Registrar of Statistics, Federation of Malaya, production of made tea in the Federation, as declared by estates, during the quarter was given as 46,308 lb. green teas and 1,146,075 lb. black teas, giving a total production for the year of 186,186 lb. green and 4,404,144 lb. black.

Palm Oil.—The average prices realised in London for shipments by the Malayan Oil Palm Pool, f.o.b. ex-installation in Malaya, for October, November and December, 1954, were $578.57, $588.43 and $608.57 per ton respectively. The average price for the year was $619.07 per ton.

Derris.—The average price of this commodity was $100 per picul until the last week of November when it rose to $101. On the 13th December the price was $110 per picul and it remained so until the end of the year.

Table II.

Singapore Prices of Various Agricultural Products.

(Dollars per picul)

Date	Copra, Sundried	Coconut oil*	Pepper, F.A.Q. Muntok white	Pepper, Gen. Muntok white	Gambier, Cube	Sago Flour, Lingga	Tapioca Flour No. 1	Oilcake, Round
1954								
4th Oct. ..	32.00	55.00	220.00	230.00	42.00	12.87½	—	14.00
11th Oct. ..	32.00	55.00	219.00	229.00	42.00	12.75	16.50	14.00
18th Oct. ..	31.00	54.50	219.50	229.50	42.00	12.75	16.50	14.00
26th Oct. ..	30.50	52.00	217.50	227.50	42.00	12.75	16.00	14.00
1st Nov. ..	29.25	51.00	211.50	221.50	42.00	12.50	16.00	13.50
8th Nov. ..	29.50	50.00	217.50	227.50	42.00	12.50	16.00	13.50
15th Nov. ..	29.00	48.50	213.50	223.50	42.00	12.37½	16.50	13.50
22nd Nov. ..	29.75	49.50	211.50	221.50	41.00	12.37½	16.25	15.00
29th Nov. ..	30.00	50.00	208.50	218.50	41.00	12.62½	16.25	15.50
6th Dec. ..	31.25	49.50	209.00	219.00	41.00	12.50	16.00	16.00
13th Dec. ..	30.00	49.50	209.50	219.50	41.00	12.50	16.25	16.50
20th Dec. ..	30.25	50.00	206.50	217.50	41.00	12.37½	16.25	16.50
28th Dec. ..	29.25	49.50	207.50	217.50	41.00	12.50	16.25	17.00

* F.O.B.

The above prices are taken from the weekly reports of the Singapore Chamber of Commerce.

FEDERATION OF MALAYA

PRODUCTION OF PALM OIL AND KERNELS.

(In long tons as declared by Estates)

Month	Palm Oil		Palm Kernels	
	1953	1954	1953	1954
January ..	3,946	4,143	1,008	1,139
February ..	3,611	3,908	923	1,066
March ..	3,778	4,442	1,031	1,210
April ..	4,061	4,674	1,066	1,228
May ..	4,209	5,251	1,076	1,396
June ..	4,122	4,188	1,056	1,114
July ..	4,500	4,580	1,150	1,162
August ..	3,980	4,694	1,000	1,236
September ..	4,180	4,319	1,059	1,157
October ..	4,083	4,333	1,063	1,154
November ..	4,026	4,642	1,064	1,273
December ..	4,602	4,776	1,173	1,336
Total ..	49,098	53,950	12,669	14,471

In December 52 estates (planted area 99,156 acres) were in production out of a total of 63 oil palm estates (planted area 109,643 acres).

MALAYAN AGRICULTURAL EXPORTS, JULY-SEPTEMBER, 1954.

Product	Net Exports in Tons.			
	Year 1952	Year 1953	July-Sept., 1953	July-Sept., 1954
Arecanuts	10,467	11,580	1,809	192 *
Coconuts, fresh † ‡ ..	94,024 †	88,315 †	24,538 †	24,034 †
Coconut oil ‡	65,113	60,779	15,908	23,039
Copra ‡	27,821 *	9,751 *	2,428 *	24,723 *
Copra cake	60,287 *	59,129 *	19,178 *	5,171 *
Gambier, all kinds ..	94 *	160 *	87 *	9 *
Palm Oil	46,008	47,579	13,804	12,385
Pineapples, canned ..	11,762	17,368	6,195	7,195
Rubber¶	582,649 ¶	572,792 ¶	148,918 ¶	159,741 ¶
Sago,—flour	19,146	28,444	8,314	5,156
Sago,—pearl	5,553	5,896	1,454	1,089
Sago,—raw	24,835 *	27,246 *	7,586 *	7,120 *
Tapioca,—flake	39 *	128 *	55 *	45
Tapioca,—flour	4,075 *	7,362 *	2,598 *	912 *
Tapioca,—pearl	6,304 *	5,474	1,107	1,980
Derris	13 *	10	2	4
‡ Copra equivalent ..	79,868	90,781	23,914	13,196

¶ production (Federation of Malaya). † hundreds in number. * net imports.

FEDERATION OF MALAYA RUBBER PRODUCTION.

(In long tons, dry weight)

Month	Estates		Smallholdings (Estimated)		Total	
	1953	1954	1953	1954	1953	1954
January ..	31,354	30,278	23,514	19,014	54,868	49,292
February ..	23,423	25,354	19,140	17,913	42,563	43,267
March ..	26,898	24,556	16,882	17,452	43,780	42,008
April ..	26,155	24,749	16,805	15,339	42,960	40,088
May ..	27,820	27,572	17,679	18,585	45,499	46,157
June ..	27,202	26,873	17,024	16,236	44,226	43,109
July ..	30,188	30,970	20,400	22,931	50,588	53,901
August ..	29,511	30,826	21,491	21,576	51,002	52,402
September ..	28,934	30,067	18,394	23,371	47,328	53,438
October ..	30,064	29,405	19,202	20,724	49,266	50,129
November ..	28,985	31,798	19,250	22,925	48,235	54,723
December ..	30,583	30,358	21,894	24,164	52,477	54,522
Total ..	341,117	342,806	231,675	240,230	572,792	583,036
Total 1952 ..	341,078		241,571		582,649	

This Table has been compiled from statistics published by the Registrar of Statistics, Federation of Malaya.

Production on smallholdings (estates of less than 100 acres) is taken as the total of purchases from smallholders reported by licensed dealers.

FEDERATION OF MALAYA

PRODUCTION OF COPRA, COCONUT OIL AND COPRA CAKE.

(in tons)

Month	Copra Production						Coconut Oil Production		Copra Cake (Poonac) Manufactured	
	Estates		Smallholdings (estimated)		Total		Oil Mills		Oil Mills	
	1953	1954 (a)	1953	1954	1953	1954	1953	1954	1953	1954
January ..	2,555	3,123	8,241	9,470	10,796	12,593	5,597	8,837	3,594	5,583
February ..	2,405	2,789	6,092	9,616	8,497	12,405	4,236	7,798	2,694	4,891
March ..	2,793	3,072	6,703	11,482	9,496	14,554	4,800	8,721	2,981	5,487
April ..	2,753	2,993	7,972	9,922	10,725	12,915	5,294	6,961	3,379	4,515
May ..	3,306	3,803	8,744	10,128	12,050	13,931	5,666	8,098	3,633	5,195
June ..	3,357	3,763	9,842	12,175	13,199	15,938	6,478	8,158	4,078	5,181
July ..	4,196	4,112	9,718	11,850	13,914	15,962	6,699	8,582	4,308	5,505
August ..	4,070	3,886	11,179	11,237	15,249	15,123	7,935	8,480	5,048	5,489
September ..	4,103	3,481	10,332	10,631	14,435	14,112	7,789	8,501	5,043	5,403
October ..	3,890	3,069	11,998	11,160	15,888	14,229	8,808	8,014	5,607	5,184
November ..	3,137	2,942	11,265	8,854	14,402	11,796	7,776	7,296	4,900	4,602
December ..	3,565	2,831	9,580	7,770	13,145	10,601	8,381	7,354	5,157	4,533
Total ..	40,130	39,864	111,666	124,295	151,796	164,159	79,459	96,800	50,422	61,568

Notes:—1. The above Table has been compiled from statistics published by the Registrar of Statistics, Federation of Malaya.

2. Estate copra production and coconut oil production are as declared by estates and oil mills respectively.

3. Statistics of smallholding coconut oil production are not available.

4. Smallholding copra production for commercial purposes is estimated from the formula: imports + estate stocks (opening) + estate production + smallholding production = exports + local oil mill consumption + estate stocks (closing).

(a) Includes copra equivalent of sales of fresh nuts by estates.

METEOROLOGICAL SUMMARY, MALAYA, SEPTEMBER, 1954.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes									Number of days							
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot	At 4 feet	Total		Most in a day	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
	°F	°F	°F	°F	°F	°F	°F	°F	°F	in.	mm.	in.						hr.	hr.	
Ipoh, Perak ..	90.8	72.3	81.5	94.3	69.5	86.2	74.2	—	—	4.06	103.1	1.28	13	10	3		1	170.00	5.67	
Kuala Lumpur, Selangor	89.6	72.7	81.1	94.7	71.1	85.2	74.8			2.91	81.9	1.34	14	10	5	3				
Sitiawan, Perak ..	88.9	72.6	80.7	92.0	69.5	82.9	74.4	84.8	85.5	2.36	59.9	0.84	14	11	4			174.55	5.82	
Kuantan, Pahang ..	88.3	71.5	79.9	91.8	67.8	83.0	73.5	81.9		11.16	283.5	1.80	20	19	7	6		149.15	4.97	
Bayan Lepas, Penang ..	86.5	73.8	80.1	89.8	70.2	81.6	76.2			8.62	218.9	1.80	19	18	3			127.75	4.26	
Malacca ..	85.3	74.0	79.7	88.1	69.8	82.9	78.7			3.31	84.1	1.61	13	10			1	166.05	5.53	
Mersing, Johore ..	87.8	71.2	79.5	91.2	69.0	83.4	72.8			5.87	149.1	1.35	16	14	1			169.50	5.65	
Alor Star, Kedah ..	86.0	73.6	79.8	89.6	68.8	79.9	76.7			12.41	315.2	2.95	18	17	1			122.70	4.09	
Kota Bharu, Kelantan ..	87.6	73.9	80.7	90.4	70.5	83.1	76.4	84.4	86.5	8.14	206.8	1.27	21	21	6			165.10	5.50	
K. Trengganu, Trengganu	87.2	72.6	79.9	91.6	70.2	81.5	74.9			9.29	236.0	1.76	21	18	7	2		177.85	5.93	
Kallang Aerodrome (S'pore)	86.2	75.9	81.1	90.0	70.0	82.3	80.5			5.40	137.2	2.74	10	8	6			127.90	4.26	
HILL STATION.																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	72.1	53.3	62.7	75.0	49.0	68.0	59.0			3.76	95.5	1.01	15	12				121.85	4.06	

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, OCTOBER, 1954.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall									Bright Sunshine		
	Means of			Absolute Extremes								Most in a day	Number of days								
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more		Total	Daily Mean	Per cent.
										in.	mm.	in.							hr.	hr.	
Ipoh, Perak ..	89.6	72.4	81.0	93.0	69.8	84.6	75.2			16.83	427.3	2.60	27	24	1				169.75	5.47	
Kuala Lumpur, Selangor	88.5	72.5	80.5	92.4	69.9	82.0	74.0			8.82	224.0	1.86	30	21	5	11					
Sitiawan, Perak ..	87.1	72.2	79.7	91.2	70.1	79.6	73.9	83.2	84.9	9.79	248.7	2.40	20	16	3	5			144.50	4.66	
Kuantan, Pahang ..	87.4	71.6	79.5	91.1	68.4	80.8	73.5	81.7		9.64	244.9	2.72	17	16	1	11			159.35	5.14	
Bavan Lepas, Penang ..	85.9	73.6	79.7	89.2	72.0	82.5	77.5			14.34	364.2	2.00	28	21	6				166.95	5.39	
Malacca ..	84.5	73.0	78.7	88.2	71.4	82.0	74.8			12.19	309.6	1.83	22	20	1				182.75	5.89	
Mersing, Johore ..	86.6	70.5	78.5	89.9	68.8	79.1	72.6			5.92	150.4	1.60	15	13					178.55	5.76	
Alor Star, Kedah ..	87.1	73.2	80.1	91.0	70.6	81.8	75.6			11.61	294.9	1.78	27	24	3	3			189.10	6.10	
Kota Bharu, Kelantan ..	85.6	73.6	79.6	87.8	71.9	80.2	75.8	83.6	85.7	14.11	358.4	1.97	22	20	6	1			200.65	6.47	
K. Trengganu, Trengganu	85.9	72.5	79.2	88.6	70.6	80.3	73.9			7.89	200.4	1.68	18	16	3	1			193.25	6.23	
Kallang Aerodrome (S'pore)	86.0	74.0	80.0	89.5	70.7	79.2	78.2			14.68	372.7	3.51	18	17	7				145.05	4.68	
HILL STATION.																					
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	71.3	56.2	63.7	75.0	44.0	68.0	61.0			19.59	497.6	1.72	28	28					94.55	3.05	

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, NOVEMBER, 1954.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall									Bright Sunshine		
	Means of			Absolute Extremes								Most in a day	Number of days								
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak ..	89.9	72.1	81.0	93.4	69.1	79.8	74.8			10.03	254.8	3.12	19	14	1		1	184.00	6.13	
Kuala Lumpur, Selangor	88.7	72.0	80.3	95.1	70.0	84.0	74.3			11.01	279.7	3.08	19	18	10	11				
Sitiawan, Perak ..	87.9	71.6	79.7	90.8	68.9	82.4	74.4	82.7	83.9	7.11	180.6	1.40	18	16	5	1		171.40	5.71	
Kuantan, Pahang ..	85.3	71.5	78.4	92.0	68.8	75.2	74.4	81.1		13.06	331.7	1.89	19	17	3	7		128.25	4.27	
Bayan Lepas, Penang ..	85.8	72.8	79.3	90.0	70.6	79.5	75.0			15.20	386.1	3.60	17	14	3			174.10	5.80	
Malacca ..	86.4	71.9	79.1	89.1	70.1	82.0	73.3			8.13	206.5	2.38	20	20				137.65		
Mersing, Johore ..	84.8	71.0	77.9	91.4	68.8	79.6	74.0			14.60	370.8	1.94	26	13				128.45	4.28	
Alor Star, Kedah ..	87.2	71.9	79.5	90.4	65.4	81.4	75.0			4.18	106.2	1.27	15	11				189.05	6.30	
Kota Bharu, Kelantan ..	84.1	72.6	78.3	87.5	68.0	76.7	76.0	82.3	84.9	16.89	429.0	4.10	18	17	1			151.85	5.06	
K. Trengganu, Trengganu	83.8	72.1	77.9	88.0	68.1	77.4	74.8			19.30	490.2	4.45	17	17		5	1	131.25	4.37	
Kallang Aerodrome (S'pore)	86.6	73.3	79.3	89.4	71.0	75.3	74.9			26.81	681.0	8.69	22	20	4			123.35	3.98	
HILL STATION.																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	71.2	57.0	64.1	75.0	51.0	66.0	62.0			11.03	280.2	2.31	17	16				121.20	4.04	

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, DECEMBER, 1954.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes									Number of days							
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Most in a day Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak ..	89.9	72.2	81.1	95.6	69.7	83.8	74.4			9.38	238.3	4.48	14	9	2		1	172.70	5.57	
Kuala Lumpur, Selangor	88.3	72.3	80.3	93.4	70.1	78.7	74.7			4.60	116.8	0.90	19	15	2	11				
Sitiawan, Perak ..	87.1	72.1	79.6	91.3	70.0	81.3	74.3	82.6	83.8	9.97	253.2	2.10	16	5	3	1		152.95	4.93	
Kuantan, Pahang ..	83.8	70.9	77.3	88.9	66.7	76.4	73.8	78.7		26.29	667.8	4.42	22	19		1		116.40	3.75	
Bayan Lepas, Penang ..	87.5	73.5	80.5	91.1	70.8	85.0	76.4			0.87	22.1	0.32	7	4	6			185.10	5.97	
Malacca ..	86.1	72.5	79.3	90.2	70.2	77.5	74.7			11.93	303.0	7.04	18	13				150.10	4.84	
Mersing, Johore ..	82.5	73.5	78.0	85.2	70.6	78.0	76.8			22.22	564.4	6.70	20	17			2	140.95	4.55	
Alor Star, Kedah ..	88.7	71.0	79.9	92.8	67.2	83.0	75.0			0.64	16.3	0.33	11	2				200.40	6.46	
Kota Bharu, Kelantan ..	83.7	72.8	78.3	85.5	69.5	79.8	77.4	79.9	81.6	25.32	643.1	7.28	20	15		1		180.95	5.84	
K. Trengganu, Trengganu	82.3	72.3	77.3	85.7	69.6	79.0	76.0			23.17	588.5	4.98	23	21		1		150.00	4.84	
Kallang Aerodrome (S'pore)	85.3	73.3	79.3	89.4	71.0	75.3	74.9			26.81	681.0	8.69	22	20	4			123.35	3.98	
HILL STATION.																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	71.2	55.9	63.5	77.0	48.0	65.0	63.0			9.74	247.4	1.55	19	19				98.55	3.18	

Compiled from Returns supplied by the Malayan Meteorological Service.